DALLAS-FORT WORTH INTERNATIONAL AIRPORT

TERMINAL D SYSTEMS REHABILITATION

PHASE TWO

CONTRACT NO. 9500708
PERMIT NO. A19-279B

TECHNICAL SPECIFICATION BOOK

Issue For Bid

February 28, 2020
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- END OF SECTION -
Incorporated into the Contract Documents will be the Dallas-Fort Worth International Airport Standard Specification Book Version 2, Published December 07, 2018, and can be found at [https://www.dfwairport.com/business/solicitations](https://www.dfwairport.com/business/solicitations).

Any Section marked as “Applicable” below is hereby incorporated into the Project Manual by reference. Any Section revised or a new Section to be added to supersede the above published document are as indicated and dated below and are hereby included in the Project Manual. Any Section included in the published book that are not included in the table below are not included in the Project Manual.

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Term. D Systems Rehab – Phase Two

Issue For Bid

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PART 1 – GENERAL

1.1 SUMMARY

A. This Section defines common terms, abbreviations, acronyms and definitions used in the Contract Documents. The terms provided below are presented in alphabetical order and do not imply order of hierarchy or importance in the Project:


2. Access Permit – A permit issued to a motor vehicle required to enter the AOA.

3. Administrator of the Code of Rules and Regulations (Administrator) – The Vice President of Public Safety for the Airport, or his/her authorized agent.


5. Air Traffic Control Tower (ATCT)

6. Aircraft Movement Area (AMA) – An area surrounding all taxiways and runways within which aircraft and vehicles operate at the direction of the Federal Aviation Administration (FAA) Air Traffic Control Tower, and all other areas within the AOA but outside the Ramp/ Apron areas.

7. Aircraft Rescue and Fire Fighting (ARFF) Road – A designated road on the Airport that is under the operational control of the DPS and Airport Operations and is used for emergency purposes.

8. Airfield Construction – All work performed within the AOA.

9. Airfield Operations – The section of the Airport Operations Department responsible for all day to day operations on and around the airfield.

10. Airport – Refer to General Provisions, Section 10.

11. Airport Board (or Board) – Refer to General Provisions, Section 10.

12. Airport Board Policy (ABP)

13. Airport CADD Standards Manual (CADD Manual) – The detailed document that contains the CADD information required to produce graphical CADD drawings for use for the Project. The CADD Manual may be located at the following:


14. Airport Design Criteria Manual – The latest edition of the design criteria document to be used for all projects on the Airport property that may be located at the following:


15. Airport Identification/Access Badge - A photo-identification badge issued by the Airport granting unescorted access to specific areas for the purpose of conducting business in accordance with the Rules and Regulations, Federal, State, and local laws and regulations, and Policies and Procedures of the Airport.

16. Airport Operations Center (AOC)

17. Airport Operations Department – Refer to “Operations Department”.


18. Allowance - As defined in Section 01 30 00.
19. Americans with Disabilities Act Accessibility Guidelines (ADAAG)
20. Approval Authority – The approval authority for ingress/egress issuance is the Airport's Vice President of Airport Operations or Vice President of Design and Construction.
21. Apron (Ramp) – A paved surface usually around terminal buildings, cargo/air freight buildings, and aircraft hangars from which aircraft operate or are parked.
22. Architect/Engineer (A/E) – The individual, partnership, firm or corporation duly authorized by the Owner to be responsible for professional services associated with architecture, engineering, or management for the Project.
23. Award - Refer to General Provisions, Section 10.
24. Baseline Schedule - The detailed schedule of coordinated construction activities prepared by the Contractor, and approved by the Owner’s Authorized Representative (OAR), to plan the Work of the Project. The Baseline Schedule shall not be modified after the approval of the OAR. Refer to Section 01 32 16 for additional information.
25. Basis of Design (BOD) – As defined in Section 01 91 00.
26. Best Management Practice (BMP)
27. Bidder - Refer to General Provisions, Section 10.
28. Business Diversity and Development (BDD) - The Airport department responsible for business diversity and minority business opportunities and monitoring diversity participation in Airport projects.
29. Calendar Day - Refer to General Provisions, Section 10.
30. Certified Movement Area Escort (CMAE) – An Airport employee or otherwise authorized person responsible for guiding a non-Security Identification Display Area (SIDA) badged person and/or vehicle though the Transportation Security Administration (TSA) passenger screening checkpoint, manned AOA gate, or AOA un-manned access gate.
31. Central Terminal Area (CTA) – The ramp areas serving Terminals A, B, C, D, and E, and the 1E ramp.
32. Certificate of Occupancy (CO)
33. Change Order - Refer to General Provisions, Section 10.
34. Clean Air Act (CAA) – USC Title 42 §§ 7401 et seq.
35. Clean Water Act (CWA) - USC Title 33 §§ 1251, et seq.
37. Code of Rules and Regulations (Code) – The published Rules and Regulations of the Airport Board as ratified by local jurisdiction for the control of parking revenue boundary crossing by vehicles located at the following link:
38. Commissioning – As defined in Section 01 91 00.
39. Commissioning Agent – As defined in Section 01 91 00.
40. Commissioning Coordinator – As defined in Section 01 91 00.
41. Commissioning Plan – As defined in Section 01 91 00.
42. Commissioning Team – As defined in Section 01 91 00.
43. Construction Site Notice (CSN)
44. Contaminated Media Management Plan (CMMP) – Refer to Section 01 33 29.06.01.
46. Contract Administrator – The person assigned by the Owner to administer the Contract. Also “Procurement Contract Administrator”.
47. Contract Amount – The overall amount or cost included in the Contractor’s Bid and shown on Page 1 of the Executed Contract.
49. Construction General Permit (CGP)
50. Contract Item (or Pay item) - Refer to General Provisions, Section 10.
52. Construction Manager (CM) - Refer to General Provisions, Section 10.
53. Construction Schedule – The schedule prepared by the Contractor updated throughout the course of the Project based on the approved Baseline Schedule.
54. Contractor - Refer to General Provisions, Section 10.
55. Contractor’s Authorized Representative (CAR) (Also Superintendent) - The Contractor’s official representative for the Project who is regularly present on the Project site, is authorized to receive and fulfill instructions from the Owner, and is responsible to supervise and direct the Contractor’s personnel on the Project. The person shall be designated by the Contractor, in writing, as the primary point of contact for all Contract related matters. Refer to General Provisions, Section 10, Superintendent.
56. Control Plaza – The entrance and exit gates at the north and south ends of the Airport that provides a stop barrier on northbound and southbound International Parkway.
57. Corrective Action – The replacement, removal, repair, or modification proposed by the Contractor to address a deviation or non-conformance issue on the Project. The Corrective Action will be approved by the Owner prior to implementation.
58. Critical Path Method (CPM) - A detailed project management scheduling technique for planning and monitoring a project.
59. Cutting and Patching – Includes, but not limited to, the cutting and patching of existing work in order to accommodate the coordination of the Work, or the installation of new Work. Patching is also defined as the repair or filling of surfaces where existing items are removed depending on the context.

60. Department of Labor (DOL) – The United States Department of Labor which is responsible for the occupational safety, wage and hour standards, unemployment insurance benefits, and reemployment services.

61. Department of Public Safety (DPS) – The Airport department responsible for safety on the Airport property.

62. Design, Code, and Construction (DCC) – The Airport department responsible for, among other functions, the development of the Airport’s various components. The Contractor is required to coordinate with DCC and obtain permits from DCC through use of certain forms as described in the Contract Documents.

63. Discharge Monitoring Report (DMR) – A regulatory term for a periodic water pollution report prepared for industry, municipalities, and other facilities discharging to the local surface waters.

64. Driver – An individual who drives or operates a commercial, governmental, institutional, and other type vehicle on the Airport.


66. Engineer - Refer to General Provisions, Section 10. Refer to Architect/Engineer.

67. Environmental Affairs Department (EAD) – The Airport department responsible for environmental issues on the Airport.

68. Erosion Control Plans (ECP)

69. Estimated at Completion (EAC)

70. Estimate to Completion (ETC)

71. Extra Work - Refer to General Provisions, Section 10.

72. Final Stabilization: A construction site status where all soil disturbing activities at the site have been completed and a uniform (e.g., evenly distributed, without large bare areas) perennial vegetative cover with a density of 70% of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or equivalent permanent stabilization measures (such as crushed stone, riprap, gabions, or geotextiles) have been employed.

73. Federal Aviation Administration (FAA) – Refer to General Provisions, Section 10.

74. Green Building Standards (GBS) – The latest edition of the Airport “Green Building Standards” document located at the following:

75. **Haul Road** – A specified roadway within the AOA serving authorized construction-related traffic.

76. **Holder** – A person, or his agent, who is granted operating authority to cross Parking Revenue Area (PRA) boundaries as specifically authorized in the Code.

77. **Hot Work** – Operations including cutting, welding, thermal welding, brazing, soldering, grinding, thermal straying, thawing pipe, or installation of roof systems requiring the use of a torch or any other open flame device or any other similar operation.

78. **Hot Work Permit** - A permit required of the Contractor from the Airport Fire Prevention and Planning Department necessary to perform any hot work operations on the Airport as part of the Project.

79. **Infrastructure, Systems, and Equipment (Systems)** - Consists of MEPS, Pavement, Signs & Markings, Grounds, Airfield Lighting and Utilities at the Airport. These systems are the responsibility of the Airport ETAM Department.

80. **Ingress/Egress Device** – A device that allows entry into the PRA by specified, unescorted vehicles.

81. **Inspector** – A person selected by the Owner assigned to make all necessary inspections and/or tests of the Work being performed or of the materials furnished or being furnished by the Contractor.

82. **Instrument Landing System (ILS)**

83. **International Building Code 2009 (IBC)**

84. **International Fire Code 2009 (IFC)**

85. **Knox Box** - The rapid access security box by the Knox Company which provides first responders with immediate access into secure buildings, campuses, residences and commercial properties.

86. **Land Use Committee (LUC)** - The committee responsible for review of the land use at the Airport consisting of representatives from all relevant Airport Departments.

87. **Materials** - Refer to General Provisions, Section 10.

88. **Material Safety Data Sheet (MSDS)** – A formal document required by the Occupational Safety and Health Administration (OSHA) that contains information about the characteristics and actual or potential hazards of a substance. It identifies the material manufacturer along with the chemical identity, hazardous ingredients, physical and chemical properties, fire and explosion data, reactivity data, health hazards data, exposure limits data, precautions for safe storage and handling, need for protective gear, and spill control, cleanup, and disposal procedures.

89. **Milestones** - A special event or specific date that is established in a schedule to monitor the progress of the Project or a portion of the Project to assist the determination of whether the Project is on schedule.

90. **Mobilization** – The actions of the Contractor to establish offices, lay-down areas, plants, and other facilities in preparation of performing the Work of the Contract.
<table>
<thead>
<tr>
<th></th>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>91</td>
<td>Multi-Sector General Permit (MSGP)</td>
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<td>92</td>
<td>Municipal Separate Storm Sewer System (MS4)</td>
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<td>93</td>
<td>National Environmental Laboratory Accreditation Certification (NELAC)</td>
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<td>94</td>
<td>Navigational Aid (NAVAID) – An apparatus, generally located within the AOA, which serves as a guide to landing aircraft.</td>
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<td>95</td>
<td>NAVAID Critical Area (NCA) – A three-dimensional area surrounding a NAVAID that, if penetrated by equipment or a stockpile, could cause interference with navigational equipment.</td>
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<td>96</td>
<td>Non-Conformance Report (NCR) – A report prepared by the Owner’s personnel to document a deviation, deficiency, or other non-conformance item on the Project.</td>
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<td>97</td>
<td>Non-Movement Area – An apron or other portion of the AOA where control and direction by the FAA Tower is not required.</td>
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<td>98</td>
<td>Notice of Intent (NOI)</td>
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<td>99</td>
<td>Not in Contract (NIC)</td>
<td></td>
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<td>100</td>
<td>Notice of Change (NOC)</td>
<td></td>
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<td>101</td>
<td>Notice of Termination (NOT)</td>
<td></td>
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<tr>
<td>102</td>
<td>Notice to Proceed (NTP) - Refer to General Provisions, Section 10.</td>
<td></td>
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<tr>
<td>103</td>
<td>Object Free Area (OFA) – As defined in Section 01 35 13.13.</td>
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<tr>
<td>104</td>
<td>Obstacle Free Zone (OFZ) – As defined in Section 01 35 13.13.</td>
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<tr>
<td>105</td>
<td>Operating Authority – Permission granted by the Administrator for a vehicle to enter the PRA in accordance with the Rules and Regulations.</td>
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<td>106</td>
<td>Operations Department - The Airport department responsible for, among other functions, the Airfield Operations Section. Also Airport Operations Department.</td>
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<td>107</td>
<td>Operator – The driver of a motor vehicle, the owner of a vehicle, or the Holder of a vehicle with Operating Authority.</td>
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<td>108</td>
<td>Owner – Refer to General Provisions, Section 10. Refer to “Airport Board”.</td>
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<td>109</td>
<td>Owner’s Authorized Representative (OAR) – A person designated by the Owner, in writing, with specific limits of authority on the Project. The OAR may be an employee of the Owner or an employee of a firm under contract with the Owner to provide specific services.</td>
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<td>110</td>
<td>Owner’s Project Requirements (OPR)</td>
<td></td>
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<td>111</td>
<td>Parking Business Unit (PBU) - The Airport department responsible for, among other functions, revenue control and operations of the PRA and issues and monitors use of parking privileges and Vehicle Access Tags (VATs.)</td>
<td></td>
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<tr>
<td>112</td>
<td>Parking Revenue Area (PRA) – The area bounded by fences, gate control equipment and arms, from which the Owner produces revenue from parking spaces.</td>
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<tr>
<td>113</td>
<td>Pay Item – Refer to “Contract Item” and General Provisions, Section 10.</td>
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</tbody>
</table>
114. Payment Application – A formal request from the Contractor to the Owner for payment of the Work, or a portion of the Work, on the Project.

115. Person – An individual, a corporation, a government or governmental subdivision, or an agency, trust, partnership, or two or more persons having a joint or common economic interest.

116. Plans - Refer to General Provisions, Section 10.

117. Pre-conditioned Air Unit (PCA Unit) – Equipment that provides cooling to the jet bridge and the aircraft while the aircraft is parked at the gate.

118. Pre-Construction Conference – Refer to Section 01 31 19.

119. Progress Meeting – Refer to Section 01 31 19.

120. Progress Payment – A payment from the Owner to the Contractor in response to a Payment Application submitted by the Contractor on the Project.

121. Project – The Project is the total Work performed under the Contract Documents.

122. Project Manual – The package containing all the Specification Sections, General Provisions, Special Provisions, and all attachments included therein, (e.g. soils reports, environmental reports, safety documents, etc.).

123. Punch List - A list prepared by the Owner's personnel to document outstanding work items during the Project Closeout process.

124. Quality Assurance (QA) - Refer to General Provisions, Section 10.

125. Quality Control (QC) - Refer to General Provisions, Section 10.

126. Quality Assurance Representative - The Airport employee or person designated by the Owner responsible for quality assurance tasks on the Project.

127. Recovery Schedule – As defined in Section 01 32 16.

128. Request for Information (RFI) - A formal request from the Contractor for additional information or clarification of information regarding an apparent inconsistency, error, or omission in the Contract Documents. The request may be based on unanticipated existing conditions on the Project site.


130. Ramp – Refer to “Apron”.


132. Runway Incursion – An incorrect presence of an aircraft, vehicle, or person on the protected area of a Runway.

133. Runway Safety Area (RSA)

134. Safety Area – A specific area surrounding Runways and Taxiways, which requires special authorization to enter.

135. Schedule of Charges – The rates and fees charged by and as approved by the Owner.
136. Security Identification Display Area (SIDA) – All areas of the Airport identified in the security program as requiring each person to continuously display on their outermost garment above the waist and below the neck, an Airport-approved identification medium unless under an escort by a CMAE. For purposes of construction and maintenance, also includes the entire area of the AOA.

137. Schedule of Values (SOV) – A detailed schedule provided by the Contractor which breaks down the Contract Amount, including Supplemental Agreements and Change Orders to date, into the Project approved cost codes divisions and/or sections of the Work. Refer to Section 01 29 73.

138. Security Threat Assessment (STA)

139. Site Mobilization Conference – Refer to Section 01 31 19.

140. Skire Unifier – Database software system used by the Owner for construction projects. All project submittals, meeting minutes, correspondence, etc. should be completed through this system unless otherwise noted in the Specification Sections or directed by the OAR.

141. Skylink Automated People Mover System – Guideway, stations, and vehicles to provide timely inter-terminal connections in the CTA.

142. Small/Disadvantaged/Minority/Women Business Enterprise (S/D/M/WBE)

143. Spill Prevention Control and Countermeasure (SPCC) – Refer to Section 01 57 19.

144. Spill Response Plan (SRP) – Refer to Section 01 57 19.13.


146. Standby Time – As defined in Section 01 21 00.

147. State – The State of Texas

148. Stockpiles – Quantities of materials, debris or spoils, which remain on the work site after work has finished for the day, etc.

149. Stormwater Pollution Prevention Plans (SWPPP)

150. Subcontractor – Any independent firm, corporation, or partnership that enters into a subcontract with the Contractor to perform a portion of the Work of the Contract.

151. Substantial Completion - The stage of the Project, or a portion of the Project, where the Project is determined by the Owner to be sufficiently complete, in accordance with the Contract Documents, so the Owner may use or occupy the Project site, or a portion of the Project site, to be used for the intended purpose.

152. Substitution - As defined in Section 01 25 13.

153. Surface Movement Guidance & Control System (SMGCS)
154. Systems – Infrastructure, equipment, and systems which are identified in the Contract Documents to be commissioned on the Project.

155. Systems Performance Group (SPG) - A group within the Airport ETAM Department which consists of the following teams:
   a. Facility Systems
   b. Watershed Management
   c. Computer Maintenance Management Systems
   d. Commissioning
      The SPG Manager is the designated Commissioning Authority (CxAuD).
   e. Geospatial Analytics

156. Taxilane – A portion of an aircraft parking area used for access between Taxiways and aircraft parking positions


158. Temporary Structure - A portable building, Conex container, or shade structure that will be on the Project site less than ninety-one (91) Calendar Days from the date of the letter of authorization.

159. Texas Administrative Code (TAC)

160. Texas Accessibility Standards (TAS)

161. Texas Pollutant Discharge Elimination System (TPDES)

162. Texas Risk Reduction Program (TRRP)

163. Texas Manual of Uniform Traffic Control Devices (TMUTCD)

164. Time Impact Analysis (TIA)

165. United States Code (USC)

166. Utility - A privately, publicly or cooperatively owned line, facility and/or system for producing, transmitting or distributing communications, power or electricity, cable television, light, heat, gas, oil, crude products, water, wastewater, and other products that directly or indirectly serve the Airport or public.

167. Utility Coordinator – An employee of the Owner or other person designated by the Owner responsible to monitor and coordinate Utilities on the Project.

168. Utility Owner – A privately, publicly, or cooperatively owned company which owns, leases, and/or operates a Utility on the Airport.

169. Vehicle – Private, commercial, governmental, institutional and any other type vehicles that operate in a way that requires crossing of the PRA boundary and have been licensed by proper authority.

170. Vehicle Access Tag (VAT)

171. Voluntary Cleanup Program (VCP)


173. Work Breakdown Structure (WBS)

**B.** Additional definitions and acronyms are included in the individual Specification Sections. Any such definitions and acronyms are meant to be cooperative with this Section.

**C.** Additional professional association and public agency names, abbreviations, and acronyms are included in Section 00 10 02.

**D.** The Contractor shall coordinate with the OAR to promptly resolve any conflicts in terminology or definitions between individual Specification Sections and this Section. Any unresolved disagreement between the Contractor and the OAR in regards to interpretation shall be resolved by the Owner.

**PART 2 – PRODUCTS**

Not Used.

**PART 3 – EXECUTION**

Not Used.

**PART 4 – MEASUREMENT AND PAYMENT**

Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 REQUIREMENTS INCLUDED

This Section includes the language definitions and standard references and agency/association acronyms included in the Contract Documents. Additional term definitions are included in the individual Specification Sections.

1.2 QUALITY ASSURANCE

A. Application: When a standard is specified by reference, the Contractor shall comply with the requirements and recommendations stated in that standard, except when requirements are modified by the Contract Documents or other applicable codes establish more stringent standards.

B. Publication Date: The publication in effect on the Bid Date, except where a specific version date or publication date is specified in the Contract Documents.

1.3 LANGUAGE DEFINITIONS

A. “Directed”, “Designated”, “Selected”, “Requested”, “Authorized”, “Permitted”, or words of similar import: Direction, designation, selection, or similar action of the Owner is intended.

B. “Require” and words of similar import: As required to complete Work and as required by the Owner.

C. “Shall” or “Must”: A mandatory requirement or activity of the Contractor or his associated Subcontractor.

D. “Perform”: Contractor shall perform operations necessary to complete Work, including furnishing of necessary labor, tools and equipment and further including and installing of materials indicated, specified or required to complete performance within the Contract Price.

E. “Provide”: Contractor shall furnish and install Work.

F. “Other acceptable manufacturer”, "equal", "acceptable equal", "equivalent", or words of similar import: Refer to products or work proven to the satisfaction of the Owner, Architect/Engineer, or any specific department of the Airport to comply with the intent of the Contract Documents.

G. "Acceptance", "acceptable", or words of similar import: Acceptance, acceptable or similar words shall be as approved by the Owner. "Accepted" or “Acceptance”, where used in conjunction with an action on the Contractor's submittals, and requests, is limited to responsibilities and duties of the Owner's Authorized Representative (OAR), Architect/Engineer, or any department of the Owner as stated in General and Supplementary Conditions. Approval does not release the Contractor from responsibility to fulfill the requirements of the Contract Documents, unless specifically stated otherwise in the Approval or Acceptance provided by the Owner.

H. "At no extra cost to Owner", "With no extra compensation to Contractor", "At Contractor's sole expense", or words of similar import: Terms shall be understood to mean that Contractor shall perform or provide specified operation of Work at no increase to Contract Amount stated in executed Contract.

I. "NIC": Work identified on the Contract Documents, which is not being performed or provided as part of the Contract; the term shall mean "Not in This Contract" or "Not Part of Work to be performed or provided by Contractor". "NIC" work is indicated as
an aid to Contractor in scheduling amount of time and materials necessary for completion of Contract.

J. "Indicated" refers to graphic representations, notes or schedules on the Plans, in other Specification Sections, or schedules, and similar requirements in the Contract Documents. Where the term "shown", "noted", "scheduled", and "specified" are used, it is to help locate the reference.

K. "Regulation" includes laws, statutes, ordinances, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within construction industry that control performance of Work, whether they are lawfully imposed by authorities having jurisdiction or not.

L. "Furnish" means supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and placing into operation in accordance with the Contract Documents.

M. "Incidental" means materials or efforts required for the completion of the Work or a work item but will not be itemized for payment individually and will be considered as part of the overall Work or construction or installation of another work item.

N. "Install" means unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, and finishing, curing, protecting, cleaning and similar operations.

O. "Installer" is a person or firm engaged by Contractor, either as employee or Subcontractor, regardless of tier, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in operations they are engaged to perform. The term "experienced", when used with "installer", means having minimum five (5) years previous experience in projects similar in size and scope to this Project, and familiar with precautions required, and has complied with requirements of authority having jurisdiction.

P. "Project site" is space available to Contractor for performance of Work, either exclusively or in conjunction with others performing construction as part of Project. The limits of Project site is shown on the Plans, or described in the Contract Documents, and may or may not be identical with description of land upon which Project is to be constructed.

Q. “Specification Section” (Section), “Project Specification”, “Technical Specification”, shall refer to the specifications identified or included in the Project Manual or refer to the requirements of a Reference Standard depending on context.

R. "Testing Laboratory" is an independent entity engaged by the Owner to perform specific inspections or tests, either at Project site or elsewhere, and to report on, and if required, to interpret results of those inspections or tests.

1.4 SPECIFICATION SENTENCE STRUCTURE

A. Simple imperative mood of sentence structure may be used in the Specification Sections which place a verb as first word in sentence. Where "perform", "provide", "install", "erect", "furnish", "connect", "test", or words of similar import are used, it shall be understood that words include meanings of the phrase "The Contractor shall..." is included before such words for interpretation.
B. Subsection titles and other identifications of subject matter in Specification Sections are intended as aid in locating and recognizing various requirements in Specification Sections. Titles do not define, limit or otherwise restrict the text of the Specification Sections text. Capitalizing of words in text does not signify or mean that words convey special or unique meanings having precedence over other parts of Contract Documents. Specification text shall govern over titling and shall be understood to be interpreted as a whole.

1.5 DOCUMENT ORGANIZATION

The organization of the Project Manual and Plans are not intended to control or to lessen responsibility of the Contractor in dividing Work among its Subcontractors, or in establishing extent of the Work to be performed by any trade.

1.6 SYMBOLS

A. Graphic symbols used in the Contract Documents are those symbols recognized in construction industry for indicated purposes. Where not otherwise noted, symbols are those defined in "Architectural Graphics Standards", published by John Wiley & Sons, Inc., Current Edition.

B. Graphic symbols used on mechanical and electrical drawings are generally aligned with symbols recommended by American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). Where appropriate, mechanical and electrical symbols are supplemented by more specific symbols recommended by the technical associations including: American Society of Mechanical Engineers (ASME), American Society of Plumbing Engineers (ASPE), Institute of Electrical and Electronics Engineers (IEEE), and similar organizations. The Contractor shall request clarification from the OAR if the symbols are unfamiliar.

1.7 REFERENCE STANDARDS

A. Reference Standard-Abbreviations:
   1. Reference standards are referred to in Specification Sections by basic designation only.
   2. Where acronyms or abbreviations are used in the Contract Documents, they shall mean recognized name of trade association, standards generating organization, authority having jurisdiction, or other organization applicable to context of requirement.
   3. Acronyms for governmental agencies and private associations are provided in this Section as an aid to the Contractor and are not all inclusive.
   4. Refer to "Encyclopedia of Associations", published by Gale Research Company, available in most public libraries, to reference unfamiliar organization acronyms or abbreviations.

B. Publications of organizations and societies listed in individual Specification Sections shall be considered an integral part of Contract Documents to extent referenced. Work shall be executed on the Project in accordance with the requirements of the Reference Standards listed to the extent such requirements do not supersede or conflict with the requirements within the Contract Documents.

C. Where a conflict may exist between requirements of two or more Reference Standards, and the Contract Documents do not clearly supersede the conflict, the Contractor shall request clarification from the OAR, prior to proceeding with activities.
which are affected by such conflict. If work activities impacted by such conflict are on-going, the Contractor shall stop work request a clarification from the OAR.

D. If the Contractor does not request conflict clarification prior to proceeding or continuing with activities impacted or controlled by such information, the Contractor shall be proceeding at risk and will not be compensated for any re-work or removal of work, labor, material, or any other costs associated with the impacted work.

E. Publications may be referenced in text by basic designation only with organizations and societies referenced by abbreviations indicated.

F. When a Reference Standard is referred to in an individual Specification Section, but is not listed by title and date, it shall be considered to be the latest edition of such reference including the appropriate supplements, amendments, revisions, or errata at the date of the issuance of the Project Manual.

G. The Contractor shall provide at the Project site copies of the Reference Standards as required, or as the OAR may request, and maintain those copies at Project site throughout construction period to ensure proper performance of the Work.

1.8 ABBREVIATIONS AND NAMES OF ORGANIZATIONS

Obtain copies of Reference Standards direct from publication source. All Airport codes and reference documents may be obtained online, as noted in various Sections, or from the Design, Code, and Construction Department (DCC).

AA Aluminum Association
AABC Associated Air Balance Council
AAMA American Architectural Manufacturers Association
AAES American Association of Engineering Societies
AAN American Association of Nurserymen
AASHTO American Association of State Highway Transportation Officials
ACEI Air Conditioning Engineers, Inc.
ACG AABC Commissioning Group
ACI American Concrete Institute
AGA American Gas Association
AGC Associated General Contractors of America
AHA American Hardboard Association
AI Asphalt Institute
AIA American Institute of Architects
AISC American Institute of Steel Construction
AISI American Iron and Steel Institute
ALSC American Lumber Standards Committee
AMCA Air Movement and Control Association
ANSI American National Standards Institute
APA American Plywood Association
<table>
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<tr>
<th>Abbreviation</th>
<th>Full Name</th>
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<tbody>
<tr>
<td>APFA</td>
<td>American Pipe Fittings Association</td>
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<tr>
<td>ARI</td>
<td>Air-Conditioning and Refrigeration Institute</td>
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<tr>
<td>ASA</td>
<td>American Subcontractors Association</td>
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<td>ASCA</td>
<td>American Spray Coaters Association</td>
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<tr>
<td>ASCE</td>
<td>American Society of Civil Engineers</td>
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<tr>
<td>ASHRAE</td>
<td>American Society of Heating, Refrigerating and Air Conditioning Engineers</td>
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<tr>
<td>ASLA</td>
<td>American Society of Landscape Architects</td>
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<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
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<tr>
<td>ASPE</td>
<td>American Society of Plumbing Engineers</td>
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<tr>
<td>ASSE</td>
<td>American Society of Sanitary Engineering</td>
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<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
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<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
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<tr>
<td>AWI</td>
<td>Architectural Woodwork Institute</td>
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<tr>
<td>AWPA</td>
<td>American Wood-Preservers' Association</td>
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<tr>
<td>AWS</td>
<td>American Welding Society</td>
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<tr>
<td>BCA</td>
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<td>NIOSH</td>
<td>National Institute for Occupational Safety and Health</td>
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NRC  National Response Center  
NRCA  National Roofing Contractors Association  
NSF  National Sanitation Foundation  
NSWMA  National Solid Wastes Management Association  
NTMA  National Terrazzo & Mosaic Association  
NWWDA  National Wood Window and Door Association  
OSHA  Occupational Safety and Health Administration  
PCA  Portland Cement Association  
PCI  Precast/Prestressed Concrete Institute  
PDI  Plumbing & Drainage Institute  
PEI  Porcelain Enamel Institute  
PS  Product Standard  
SBCCI  Southern Building Code Congress International  
SDI  Steel Deck Institute  
SDI  Steel Door Institute  
SIGMA  Sealed Insulating Glass Manufacturing Association  
SJI  Steel Joist Institute  
SMACNA  Sheet Metal and Air Conditioning Contractors' National Association  
SPIB  Southern Pine Inspection Bureau  
SPRI  Single Ply Roofing Institute  
SSPC  Steel Structures Painting Council  
TAS  Technical Air Series  
TCA  Tile Council of America, Inc.  
TCEQ  Texas Commission on Environmental Quality  
TDSHS  Texas Department of State Health Services  
TxDOT  Texas Department of Transportation  
UBC  Uniform Building Code  
UL  Underwriters Laboratories, Inc.  
UPC  Uniform Plumbing Code  
USDA  United States Department of Agriculture  
USDC  United States Department of Commerce  
USPS  United States Postal Service  
WRI  Wire Reinforcement Institute  
WWPA  Woven Wire Products Association
REFERENCE STANDARDS
Section: 01 10 02

PART 2 – PRODUCTS
Not Used.

PART 3 – EXECUTION
Not Used.

PART 4 – MEASUREMENT AND PAYMENT
Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

The Work of this Contract is comprised of the following:

1. The installation of splashguards on existing rooftop storm drain pipes on the ramp level. The splashguard is to prevent the storm drain pipes from overflowing during heavy rains.

2. The rehabilitation or replacement of ramp level protection bollards at various locations. The existing bollards protecting structural columns and baggage handling equipment at baggage make-up devices have been damaged or removed.

3. The replacement of radiant heaters above ramp level baggage handling system make-up units. The units have served their useful life and must be replaced with new similar heaters.

4. The replacement of air handling unit (AHU) 5-18 Cooling Coils. Due to control system component failures, the chilled water coils have been subjected to freezing air temperatures. The coils are beyond reasonable economical repair and must be replaced.

5. The installation of Variable Air Volume (VAV) cooling for several elevator machine, mechanical and communication rooms. The VAV units will be connected by means of new branch ducts to nearby existing supply air ducts. Any existing VAV terminal units would require resetting and rebalance of air flow.

6. The installation of a dedicated Fan Powered Variable Air Volume terminal unit with both cooling and heating capabilities to serve a single room used by Customs and Border Protection (CBP).

1.2 FORMS

A. The Contractor and all Subcontractors must obtain and pay for all Airport Identification/Access Badges and Access Permits as required by the Airport.

B. All appropriate forms and applications must be obtained, completed and submitted. A minimum required list of forms and applications is as follows:

1. AOA Area Access or Parking Revenue Area (PRA) Access Permits Form (1 page). This form can be obtained from Airport Design, Code, and Construction Department (DCC).

2. Access Badge Application (3 pages). This form can be obtained on the Airport website: https://www dfwairport com/badge/

1.3 CONTRACT TIME & SCHEDULE MILESTONES

A. The Contractor shall sequence and stage the Work in accordance with the requirements of the Contract Documents to meet the following interim requirements and Final Completion date.

1. 200 consecutive Calendar Days for Substantial Completion, from the date set forth in the Notice to Proceed (NTP).

2. 60 consecutive Calendar Days for Final Completion, from the date set forth for Substantial Completion.
3. Total Contract Time = 260 consecutive Calendar Days from NTP.

B. The Owner reserves the right to request the completion of work based on critical Milestones established in the Contract Documents.

C. The Owner reserves the right to apply Liquidated Damages associated with the request the completion of work based on critical Milestones.

1.4 HOURS OF WORK

A. The Work may be performed in all areas up to 24 hours a day, 7 days a week, as necessary to meet the Project completion dates, except as noted below.

B. Exceptions to above work hours:

1. Any Work on the Ramp Level may be restricted to the following:
   a. From 22:45 hours to 05:15 hours.
   b. Work activities within these areas may be canceled and the area reopened in the event of airfield emergencies, late airline complexes, and

2. There are two types of Holiday Blackout periods. One governs the area within the Air Operations Area (AOA) and the other holiday blackout periods governs the area outside of the Air Operations area. The following construction blackout dates are recognized for the Project:

   a. Airfield Blackout Dates
      1) No airfield closures or lighting circuit lockouts should be scheduled beginning at 2200 hours on Friday night, November 22, 2019, until 2200 hours on Monday night, December 2, 2019.
      2) No airfield closures or lighting circuit lockouts should be scheduled beginning at 2200 hours on Wednesday night, December 18, 2019, until 2200 hours on Thursday night, January 2, 2020.

   b. Landside Blackout Dates
      The following 2019 and 2020 dates have been established as construction blackout dates in the landside and customer service areas. During the noted landside Holiday blackout dates any work that impacts ramp level operations, roadways, guests inside the terminals and non-emergency utility outage requests, will normally not be approved. Work and utility outages that do not impact stakeholder operations or have limited impact will be evaluated on a case by case basis during the blackout periods. The dates listed are the primary dates and others may follow:
      • Labor Day – Thursday, August 29 at 00:00 am through Tuesday, September 3, 2019 at 11:59 pm
      • Thanksgiving – Thursday, November 21 at 00:00 am through Tuesday, December 3, 2019 at 11:59 pm
c. For all utility outages, a Utility Outage Request form must be submitted seven days in advance to Poweroutage@dfwairport.com. For power outage requests, all impacted panel schedules must be submitted with the request. Operations will review and if needed, coordinate a stakeholder meeting to discuss mitigation plans. One hour prior to all utility outages, the requestor must call the Airport Operations Center at 972-973-3112 one hour prior to the scheduled outage for a final go/no-go. The Utility Outage Request form may be found on https://www.dfwairport.com/operations/ or you may request a form from PowerOutage@dfwairport.com.

C. Refer to the drawings for additional work hour limitations related to the scope for each Work Item.

PART 2 – PRODUCTS
Not Used.

PART 3 – EXECUTION
Not Used.

PART 4 – MEASUREMENT AND PAYMENT
Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY

This Section shall govern the field location of all underground existing Utilities and sub-drains in construction areas of the Project. It shall include, but not be limited to, the location of electrical and communication ducts, airfield lighting and control cables, fiber optic and Federal Aviation Administration (FAA) Navigational Aid (NAVAID) cables. It is the intent of this Section to provide for the location of existing Utilities by hand digging, particularly underground cables and NAVAIDs.

NOTE: The significance of protecting and maintaining all Utilities cannot be overstated. Direct-buried fuel, gas and water pipes, and electric, fiber-optic, navigational aid, security and telephone cables are found both inside and outside the Air Operations Area (AOA), and are very susceptible to damage during trenching and earthmoving operations. Any cut NAVAID cable could have disastrous consequences.

1.2 CONSTRUCTION METHODS

A. It is the sole responsibility of the Contractor to locate all Utilities on the construction site except for FAA lines. It is the Contractor’s responsibility to coordinate with the FAA the location of the FAA lines.

B. Utilities, utility appurtenances, and cables encountered by the Contractor during the construction of this Project shall be protected by the Contractor as needed for construction and to conform to the finished grades on the Project. Use of mechanical equipment of any kind to verify Utility locations are expressly prohibited. The Contractor shall immediately repair any damaged Utilities at his own expense to the satisfaction of the respective Airport department and/or the FAA.

C. The Contractor shall coordinate with all Utility Owners maintaining facilities at the Airport as well as Utilities owned by the Owner through the Owner’s Authorized Representative (OAR) prior to any excavation/digging and ensure all available as-built information has been provided, and provide the OAR with written documentation of how the Utility location was verified.

D. The Contractor shall continuously maintain Utilities for facilities and/or systems, which are or may be affected by the Work of the Project. Refer to the Utility Location Sign-Off Sheet included in Section 01 18 16.13. The Contractor shall prepare and maintain a contingency plan, approved by the OAR, to restore to service all Utilities and/or control/signal cables which may be placed out of service or damaged during performance of the Work. The Contractor shall provide immediate notification to the Airfield Operations Department and Airport Maintenance through the OAR on all damage to underground Utilities, and follow up with written reports. Refer to the Underground Utilities Damage Report included in Section 01 18 16.14.

E. Accurately locate all the routing of underground cable and Utilities within the Project areas to be excavated, trenched, or drilled. The location shall be accomplished by hand digging and once located, placing highly visible and durable markers along all such cable and Utility routes at intervals of not greater than 25 feet. Obtain the OAR approval of proposed marking devices. Use semi-permanent markers that are low profile, frangible and non-metallic within the Runway and Taxiway Safety Areas, and navigational and restricted zones. The Contractor shall maintain these markers in their original locations throughout the Project, and shall also be responsible for
providing and maintaining a field survey and plan of the marker locations replacing any disturbed markers at its own expense.

F. Do not use power equipment with teeth when excavating within five (5) feet of an area of marked cables unless the cables or other Utilities are completely visible and the Contractor can guarantee that they will not be nicked, severed, or damaged in any way.

G. The Contractor will be responsible for the completion of all forms required by the Owner and the assemblage of all the executed forms into a meeting binder (commonly called a “Dig Book”) which will require signatures and formal approval by the Owner. The Dig Book must also be kept onsite by the Contractor until the Work is complete. Is it suggested that the Contractor allow at least one (1) month for the assemblage and approval of all requirements.

H. Contents of the Dig Book:
1. Develop an overall utility and cable chart/map that shall be maintained throughout the construction. This chart/map shall have all underground utilities and cables shown, including the field survey information and other Utility information provided by the FAA, telephone, electrical and other Utility Owners, and shall reside in the Contractor's office. This chart/map shall be furnished to the Owner at the completion of the Project.

2. At the beginning of each work period check the utility and cable chart/map for cables and utilities in the areas of work. If any of the Contractor's personnel removes the chart/map from the office, then that person will initial a sign-out sheet for the chart/map.

3. Develop and provide a comprehensive plan and procedures for controlling vehicle travel to and/or within AOA work areas that avoids underground cables to the extent possible. Obtain the OAR approval of the plan prior to commencing work operations within the AOA. Strictly adhere to the approved plan and procedures throughout the duration of the Project.

4. The cable or Utility shall be exposed by hand (pot-holed) after the Contractor performs a circuit lock out. The cable or Utility must be visibly exposed. The Contractor shall verify adjacent width of five (5) feet parallel to each side of the exposed cable for any other existing cables.

5. Both the OAR and the Contractor's Authorized Representative (CAR) must sign off that the cable or Utility has been located before any work is started. Coordinates of the cable or Utility shall be recorded at this time and placed on the As-Built Drawings and the cable chart/map.

6. Operators or any other Contractor's personnel who observe sand or bedding material in trenches or excavations shall cease operations and notify their supervisor immediately.

I. If the Contractor does damage a NAVAID cable that has been previously located, the Contractor shall be required to repair the cable and install either a pull box or manhole and/or complete cable replacement depending on the type and or size of the NAVAID cable. Whether a pull box, manhole, or complete cable replacement is required, it shall be totally the decision of the FAA. All cost related to the said damaged NAVAID shall be the sole responsibility of the Contractor.
J. Any irrigation lines that are damaged must be repaired by a licensed irrigation company.

PART 2 – PRODUCTS
Not Used.

PART 3 – EXECUTION
Not Used.

PART 4 – MEASUREMENT AND PAYMENT
Not Used.

– END OF SECTION –
EXCAVATION SHALL NOT PROCEED IN THE AREA DESCRIBED BELOW UNTIL THIS FORM IS PROPERLY COMPLETED.

DATE: ________________

LOCATION OF UTILITY: ___________________________________________

*DFW MAPSCO#: ________________________________________________

TYPE OF UTILITY: ________________________________________________

UTILITY FIELD LOCATION CONFIRMATION#: ______________ DATE: __________

DATE FIELD LOCATION OCCURRED: ______________ N/A: ______________

DATE UTILITY UNCOVERED FOR OBSERVATION: ______________ N/A: ______________

LOCATION UTILITY WILL IMPACT PROPOSED WORK: YES ____ NO ____

COMMENTS:
______________________________________________________________
______________________________________________________________
______________________________________________________________

DATE AS-BUILT INFORMATION FOR UNCOVERED UTILITY OBTAINED: ______________

______________________________________________________________

The Contractor verifies, by signature below, that a thorough examination of all available as-built information has been completed and that field investigation(s) to locate any Utilities in the Work area, where the proposed excavation will occur, has been Completed.

Contractor’s Authorized Representative: ________________ Date: ________________

Concurrence by
Owner’s Authorized Representative: ________________ Date: ________________

cc: Utility Coordinator
Construction Manager
Quality Assurance Representative
AOPS (6/91) Dallas-Fort Worth International Airport

*Note: MAPSCO refers to the latest edition of the Fort Worth Street Guide published by the Kappa Map Group.

- END OF SECTION -
DATE: ________________ TIME: ________________ CONTRACT No.: ________________

PROJECT: ______________________ CONTRACTOR: ______________________

UTILITY: ______________________

LOCATION (Attach sketch, including location, depth, etc.): ______________________

TIME/DATE RETURNED TO SERVICE: ________________ WAS UTILITY MARKED? ______

WAS EXCAVATION EQUIPMENT USED? WHAT KIND? ______________________

DESCRIBE HOW DAMAGE OCCURRED: ______________________

WHAT PRECAUTIONS WERE TAKEN? ______________________

COMMENTS/RECOMMENDATIONS: ______________________

ATTACHMENTS: ______________________

SIGNED ______________________

cc: Airfield Operations Projects and Standards Administrator
    Construction Manager

- END OF SECTION -
PART 1 - DESCRIPTION

1.1 GENERAL

A. Some of the Work of this Contract must be constructed at locations that are critical to the overall operation of the airfield. The Contractor shall coordinate the scheduling and sequencing of the Work with the Owner’s Authorized Representative (OAR) in a manner that avoids unacceptable construction impacts on airfield operations; however, aircraft arrivals and departures are subject to weather conditions and cannot always be accurately predicted. Portions of the Work will require the Contractor to work within allotted time frames that could be subject to changing airfield conditions. On occasion, the OAR, on short notice, may direct the Contractor to temporarily stop work for departing and/or arriving aircraft. The purpose of this Section is to establish a means to compensate the Contractor for temporary disruptions to his work resulting from airfield operations. Any compensable disruptions, further identified as Standby Time, must be approved by the OAR.

B. Work under this Section is subject to the requirements of the Contract Documents.

1.2 SUBMITTALS

A. During the Mobilization phase of the Contract, the Contractor shall submit a listing of hourly billing rates (idle and operating rates) for each type of equipment that will be used on the Project. The OAR will review these rates and negotiate any differences with the Contractor. The agreed upon equipment rates will be used to pay for any approved Standby Time.

B. Only standard or regular equipment scheduled for actual use and operation shall be subject to Standby Time compensation. Any equipment provided as replacement for any regular equipment will not be subject to Standby payment.

PART 2 - MATERIALS

2.1 STORAGE OF MATERIALS

The Contractor will not be allowed to stockpile materials in any location that could interfere with airfield operations unless the Contractor can demonstrate to the OAR that: (1) the materials must be staged in critical areas to facilitate construction, and (2) the Contractor will be able to remove the materials within 30 minutes of notification. The final determination of timely removal of such materials will be the responsibility of the OAR.

2.2 PAYMENT FOR IMPACTS TO MATERIALS

If a Standby Time period results in impacts to materials that renders the materials unusable, the Contractor will submit invoices to the OAR documenting the costs for such materials. For example, if the Contractor has concrete on site that cannot be used due to a Standby Time period, resulting in the concrete being discarded, the costs for this material may be submitted for reimbursement. No Contractor or Subcontractor mark-up will be allowed for this type of material reimbursement.
PART 3 - EXECUTION

3.1 PROJECT WORK SCHEDULE

Prior to beginning construction, the Contractor shall prepare and submit a Construction Schedule to the OAR for review and approval. In preparing the Construction Schedule, the Contractor will incorporate phasing details and construction restraints set forth in the Contract Documents. During the review of the Construction Schedule, the OAR will conduct a meeting with the Contractor and Airfield Operations to review potential airfield operational impacts on the Construction Schedule. The Contractor, as necessary, will modify the Construction Schedule to minimize any potential impacts.

3.2 DAILY WORK SCHEDULES

Prior to the end of each Working Day (by 6:00 pm local time), the Contractor shall attend a schedule meeting with the OAR to review the next day’s schedule for work in proximity to an active Taxiway or Runway. Prior to the meeting, the OAR will check with Airfield Operations Department to determine which Taxiway and Runway configurations are planned for the next 24 hours. During the daily schedule meeting, the Contractor and OAR will determine which construction activities can be scheduled for the following 24 hours, and those construction activities that will be significantly impacted by planned airfield operations and will not be approved for the following day/night. For any work activity the OAR determines could be impacted by an airfield operation, the Contractor will provide a plan for removing equipment, materials, and manpower from that area within thirty (30) minutes of notification.

3.3 AUTHORIZATION AND CANCELLATION OF WORK

At the daily schedule meeting, the OAR will authorize the Work for the following 24 hour period. If airfield conditions change such that the Contractor’s scheduled work will be significantly impacted, and the OAR notify the Contractor at least four (4) hours prior to the start of the scheduled shift that the work will be cancelled, the Contractor will not be eligible to receive any additional compensation as a result of the cancellation.

3.4 ADDITIONAL COMPENSATION

A. If a Contractor is authorized to perform work that is not cancelled four (4) hours prior to the start of the scheduled shift, and airfield operations require the OAR to either temporarily stop the work or terminate the work for the day, the Contractor will be eligible for compensation as follows.

1. Work is Terminated for the Day Prior to Starting

   If the Contractor’s crew for the cancelled work arrives at the site and is sent home, the Contractor will be compensated for two (2) crew hours based on the hourly rates provided in certified payrolls. If the Contractor diverts the crew to other Project work, no additional compensation will be approved. The Contractor will also be compensated for two (2) hours of idle equipment time for any equipment that was scheduled for the cancelled work. If the Contractor diverts the equipment to other Project work, no additional compensation for lost equipment time will be approved. If the Contractor has rented specialized equipment for a portion of the work that was cancelled, and the Contractor incurs additional rental time as a result of the cancellation, the OAR may approve additional payment for more than two (2) hours of the shift. Before the OAR will consider this additional
payment, the Contractor must provide information (actual invoices) quantifying the Contractor’s costs.

2. Work is Temporarily Stopped and Restarted

If the Contractor is directed to temporarily stop any portion of work as a result of airfield operations, the Contractor will be compensated for the labor impacted by the temporary stoppage. The OAR will document the crew members and the duration of the temporary stoppage. Additional compensation will be calculated using hourly rates provided in certified payrolls. If the Contractor’s production is not impacted by the temporary stoppage, no Standby Time compensation will be approved. Additional compensation for equipment Standby Time will only be authorized for impacted equipment that directly reduced the Contractor’s production during the temporary stoppage. This compensation will be calculated using approved idle time rates.

3. Work is Started and Terminated for the Day

If the Contractor is directed to stop an element of work for the remainder of the day, additional compensation will be authorized for two (2) hours of impacted labor if, at the time of the stoppage, the impacted labor has worked six (6) hours or less for the day/night. For any stoppage after six (6) hours of work, additional compensation will be made for the difference between eight (8) hours and the actual time worked. Compensation for labor will be calculated based on hourly rates provided in certified payrolls. Additional compensation for equipment will be calculated in the same manner provided the OAR agrees that the lost equipment time reduced the Contractor’s production for the shift. Compensation will be calculated using approved idle time rates.

4. Standby Time Documentation

For any component of authorized work temporarily stopped by the OAR due to the airfield operations, the Contractor shall complete the “Standby Time Work Report” form included in Section 01 21 00.01. At the end of the work shift the Contractor and OAR will verify the labor and equipment impacted, the duration of the temporary stoppage, and any materials determined to be discarded as a result of the temporary stoppage event.

**PART 4 - MEASUREMENT AND PAYMENT**

4.1 COMPENSATION FOR STANDBY TIME

Compensation for Standby Time will be authorized for the Contractor in accordance with the criteria set forth in this Part 4. Compensation will be limited to the Contractor’s labor and equipment costs and materials determined to be discarded or lost due to the event. Materials discarded due to delays or a work stoppage event which qualify as Standby Time based on the criteria herein, will be compensated at the discretion of the Owner based on the determination of the OAR. All compensation requests must be documented on the “Standby Time Work Report” form in Section 00 21 00.01. In calculating compensation for Standby Time, the OAR will not authorize any Contractor or Subcontractor mark up on materials, labor, or equipment.
4.2 ADDITIONAL CONTRACT TIME

Additional Contract Time will be allowed for any Working Day during which all of the following criteria are met:

A. The impacted work was scheduled by the Contractor and authorized by the OAR.
B. The Contractor can demonstrate that the impacted work is critical to meeting one or more of the Contract Milestones in the Project Schedule or construction phase durations.
C. The temporary work stoppage impacts more than four (4) hours of scheduled work.
D. The Contractor submits a written request in accordance with General Provisions 80-9 “DETERMINATION AND EXTENSION OF CONTRACT TIME”, requesting that additional Calendar Days be added to the Contract Time.

4.3 BASIS OF PAYMENT

Payment will be made on a time and material basis as specified above and supported by a completed “Standby Time Work Report”.

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<th>ITEM</th>
<th>UNIT DESCRIPTION</th>
<th>UNIT</th>
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<tbody>
<tr>
<td>01210</td>
<td>Standby Time Allowance</td>
<td>per Allowance</td>
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- END OF SECTION -
 Dallas-Fort Worth International Airport

STANDBY TIME WORK REPORT

DATE OF WORK

Work Report #

CONSTRUCTION INSPECTOR
CONSTRUCTION MANAGER
CONTRACTOR

WORK REPORTS TO BE COMPLETED DAILY WHEN EXTRA WORK (AUTHORIZED OR UNAUTHORIZED) IS IN PROGRESS. FORM SHALL BE SUBMITTED TO CONSTRUCTION MANAGER FOR SIGNATURE DURING THE DAY FOLLOWING SUCH WORK.

GENERAL CONTRACTOR

WORK DESCRIPTION, LOCATION

SUBCONTRACTOR

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<th>CLASSIFICATION</th>
<th>HRS</th>
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</table>

MATERIAL USED

FULL DESCRIPTION | QTY

TOTAL LABOR / PERSONNEL

CORRECT AS TO TIME, MATERIALS AND EQUIPMENT SUBMITTED

Contractor DATE Construction Manager DATE

- END OF SECTION -

Dallas Fort Worth International Airport
Standard Specification Book V2

December 7, 2018
PART 1 – GENERAL

1.1 SUMMARY
This Section covers the requirements for Contractor requests for a product Substitution on the Project.

1.2 DEFINITIONS
Substitution: A request for a change in a product, material, equipment and/or method of construction required by Contract Documents after Contract Award are considered a Substitution. The following are not considered a Substitution:

A. A Substitution requested by Bidders during the bidding period, and accepted prior to Award, is considered as included in the Contract Documents, and is not subject to requirements specified in this Section.

B. Specified options of products and construction methods included in the Contract Documents.

C. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.3 CONTRACTOR'S REPRESENTATION
A request for a Substitution is a representation that the Contractor:

A. Has investigated proposed product and has determined that it is equal to or superior in all respects to that specified in the Contract Documents.

B. Will provide the same or better warranties or bonds for substitution as for product specified in the Contract Documents.

C. Will coordinate the installation of the accepted substitution into the Work, and will make such changes as may be required for the Work to be complete in all respects.

D. Waives claims for any additional costs caused by the Substitution, which may subsequently become apparent.

E. Has provided complete cost data which includes related costs under this Contract, but not costs under separate contracts.

1.4 OWNER'S DUTIES
A. The Owner, either directly or through an Owner's Authorized Representative (OAR), will determine the acceptability of proposed substitutions.

B. The Owner and/or OAR will review the Contractor's request for a Substitution with reasonable promptness.

C. The OAR will notify the Contractor, in writing, of the decision to accept or reject the request for a Substitution.

D. The Owner or the Architect/Engineer review, acceptance, or failure to take exceptions to a Substitution or other review document, shall not relieve the Contractor of the responsibility for the Substitution meeting performance or other requirements of Contract Documents.
PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Contractor’s Options

1. For products specified only by reference or performance standards, select any approved product and manufacturer meeting that standard.

2. For products specified by naming several products or manufacturers, select any approved product and named manufacturer which complies with the Specifications.

3. For products specified by naming one or more products and manufacturers, there is no option, unless a Substitution is approved.

B. The OAR will consider a request from the Contractor for a Substitution of a product in place of the one specified only on the Product Substitution Form included in Section 01 25 13.01.

C. Within a period of 30 Calendar Days after Award of the Contract or respective subcontract, the OAR will consider formal requests from Contractor for Substitutions in place of the products specified in the Contract Documents. After the end of that period, Substitution requests will be considered only if specified product is no longer manufactured.

D. Substitutions will only be considered when the Contractor can demonstrate to the satisfaction of the OAR that the request for a substituted product is reasonable for the Project.

E. The Contractor shall submit separate request for each Substitution, supported with complete data, drawings and appropriate samples substantiating compliance of proposed substitution with Contract Documents, including:

1. Complete data substantiating compliance of the proposed Substitution meeting or exceeding the requirements in Contract Documents:
   a. Product identification, including manufacturer’s name and address.
   b. Manufacturer’s Literature: Identify with product description, reference standards, and performance and test data.
   c. Drawings, samples, as applicable.
   d. Name and address of similar projects on which product has been used, and date of each installation.

2. Itemized comparison of the proposed Substitution including its quantities with product specified and list significant variations.

3. Data relating to changes in Construction Schedule and indicating any impact of proposed Substitution on overall Contract Time.


5. Changes required in other elements of Work and to any construction performed by Owner or separate Contractors, if any, to accommodate the proposed Substitution.

6. Availability of maintenance service and source of replacement parts and materials, as applicable.
7. Provide test data from an independent testing laboratory to show compliance with performance characteristics specified in the Contract Documents as compared to the product to be replaced with the Substitution.

8. Designation of required license fees or royalties.

F. Properties including, but not limited to the following, will be considered as applicable:
   1. Physical dimension requirements to satisfy space limitations.
   2. Static and dynamic weight limitations, structural properties.
   3. Audible noise levels.
   5. Interchangeability of parts or components.
   6. Accessibility for maintenance, possible removal, or replacement.
   7. Colors, textures, and compatibility with other materials, products, assemblies, and components.
   8. Equipment capacities and performance characteristics.

G. A Substitution will not be considered for acceptance when:
   1. Indicated or implied on shop drawings, or any product data submittal without a formal request from Contractor for a Substitution.
   2. Requested directly by Subcontractor or supplier.
   3. Acceptance will require substantial revision of Contract Documents or increase in the Contract Time.
   4. Any increase in the Contract Amount.

H. The Contractor or any Subcontractor shall not order or install any substitute product without the written acceptance of the OAR.

I. The Contractor assumes full responsibility for justifying each Substitution and the decision of acceptance or rejection of proposed Substitution by the Owner will be final.

J. If a proposed Substitution is not accepted, the Contractor shall provide a specified product or material meeting the requirements of the Contract Documents.

K. The Contractor shall reimburse the Owner for any expenses incurred by Owner or the Architect/Engineer for modifications to the Contract Documents required by any Contractor requested Substitution accepted by the Owner.

PART 3 – EXECUTION

3.1 SUBSTITUTION REQUEST

The Contractor shall complete and submit a Product Substitution Form included in Section 01 25 13.01 for each proposed Substitution.

PART 4 - MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
## SUBSTITUTION REQUEST

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>SPECIFIED</th>
<th>PROPOSED</th>
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<tbody>
<tr>
<td>1. Manufacturer and model number</td>
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<td>2. Governing quality standards</td>
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<td>3. Appearance/finish</td>
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<td>4. Ease of operations</td>
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<td>5. Maintenance/useful life</td>
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<td>6. Source of maintenance service and replacement materials</td>
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<td>7. Suitability for climate and/or operating conditions</td>
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<td>8. Effect on schedule</td>
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<td>9. Other significant differences</td>
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<td>10. Changes required to other elements of work due to substitution</td>
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<tr>
<td>11. Explanation of how substitution is beneficial</td>
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</table>

Complete SPECIFIED and PROPOSED sections for each item as applicable.
To: Construction Manager:

Project Name:

SPECIFIED ITEM:

The undersigned Contractor’s Authorized Representative (CAR) requests consideration of the following:

PROPOSED SUBSTITUTION:

1. Attached data include product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified, both on the proposed substitution and the original specified product.

2. Attached data also includes description of changes to Contract Documents, which the Substitution will require for its proper installation.

The undersigned CAR states that the following paragraphs are correct, unless as are modified on the attachments.

1. The proposed Substitution does not affect dimensions in the Contract Documents.

2. The undersigned CAR agrees to pay for changes to the building design, including engineering design, detailing and construction costs caused by the Substitution.

3. The proposed Substitution will have no adverse effect other trades, the Construction Schedule, or specified warranty requirements.

4. Maintenance and service parts will be locally available for the proposed Substitution.

The undersigned CAR further states that the function, appearance, and quality of the proposed Substitution are equivalent or superior to the specified item in the Contract Documents.

5. Cost Reduction to the Owner: $
## ACCEPTANCES:

<table>
<thead>
<tr>
<th></th>
<th>Contractor’s Authorized Representative (CAR) Acceptance:</th>
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<tbody>
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<td>1.</td>
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<td>2.</td>
<td>Owner’s Authorized Representative (OAR) Acceptance:</td>
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<td>3.</td>
<td>Architect/Engineer Acceptance:</td>
<td>Representing:</td>
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- Accepted as Noted
- Not Accepted
- Received too late
- Resubmit with complete information

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY

This Section covers the process for the Contractor to request a clarification on the Project Documents through a Request for Information (RFI) during the Project.

1.2 GENERAL

A. An RFI is intended for the Contractor to request a clarification and/or interpretation of the Contract Documents due to an apparent inconsistency, error, or omission, or due to unanticipated existing conditions.

B. An RFI is not intended for by the Contractor to request substitutions, proposed changes to the Contract Documents, the resolution of any non-conforming work, or for general questions not related to the Contract Documents.

C. The RFI process is intended to be a cooperative effort between the Contractor, the Owner, and the Architect/Engineer to clarify any apparent errors, omissions, or ambiguities in the Contract Documents while maintaining the progress of the Work.

1.3 RFI NUMBERING

A. The Contractor shall number each RFI sequentially utilizing a three digit code starting with “001” and continuing “002”, “003”, etc.

B. A resubmittal or revised RFI on the same subject shall be numbered utilizing the same three digit code and including a letter suffix beginning with “A” and continuing sequentially. (e.g. The second revision to the second RFI would be numbered “002B”. ) In such case, the previous edition of the RFI shall be acknowledged to be superseded and thereby closed in the description of revised RFI.

C. A three digit alphanumeric prefix designation may be utilized on a large project, or a project involving numerous buildings or structures. (e.g. The second RFI on “Building A” could be “BDA-002”).

D. The Contractor shall consult with the Construction Manager (CM), whether such prefix designation is required for the Project and shall maintain the prefix chosen unique designation for each building or structure consistent throughout the Project.

1.4 DOCUMENTATION

A. All notifications, documentation, and transmittals between the Contractor and the Owner’s personnel for the RFI process shall utilize the Skire Unifier software application, unless an alternate form of transmission is directed by the Owner for the Project.

B. If an alternate form of transmission is directed for the Project, all notifications, documentation, and transmittals shall utilize that form of transmission.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SUBMISSION

A. The Contractor shall submit an RFI to the CM identifying the subject and providing all necessary reference information.
B. The Contractor shall submit only a complete RFI including all attachments necessary to adequately explain the subject of the RFI.

C. The Contractor shall limit the RFI to only one (1) Contract Item or only one (1) Specification Section reference.

3.2 RESPONSE

A. The CM will review the RFI to respond or forward to the Architect/Engineer or other Owner personnel for input or reject the RFI if it is determined to be incomplete.

B. The Architect/Engineer or other Owner personnel will review the RFI and provide a response to the CM or request additional information to adequately review and respond to the RFI.

C. The CM will forward the response or request additional information from the Contractor.

D. If the CM requests additional information, the Contractor shall provide such information within [two (2) Working Days] unless otherwise allowed by the CM.

E. If the Contractor does not provide the requested information within [two (2) Working Days], the CM will close the RFI. In such a case, the Contractor may submit a new RFI concerning the subject matter when the requested information can be provided.

F. If the Contractor submits a new RFI concerning a previously rejected or closed RFI without the previously requested information, the RFI will be rejected by the CM.

G. When the CM returns the response to the Contractor, the RFI will be closed.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 GENERAL
This Section covers the requirements for the Contractor to prepare and submit a Payment Application.

1.2 FORMAT
A. The Contractor shall use the pay request forms provided at the Project Pre-Construction Conference.
   1. Airport Form E-184 – Construction Contract Pay Request
   2. PPAR Form – Pay Period Activity Report
   3. Government Form 702
   4. Government Form 703
B. Adequate copies of the pay request forms may be obtained from the Owner’s Authorized Representative (OAR).

1.3 PREPARATION OF APPLICATIONS
A. The Contractor shall complete the required information on the appropriate pay request forms.
B. The forms shall be certified by signature of Contractor’s Authorized Representative (CAR). The copies submitted to the OAR shall include an original signature in blue ink of the CAR.
C. The forms shall include data from the current approved Construction Schedule with the Schedule of Values or from an authorized computer produced cost control reports, as applicable. Each line item for portion of Work performed during the represented time period shall include a percent completed for the time period represented and a cumulative percent completed to date.
D. Prepare an application for final payment as specified in the General Provisions, Section 90, Measurement and Payment.

1.4 SUBMITTAL PROCEDURES
Submit one (1) originally signed copy of the pay request forms at times designated in the schedule provided at the Pre-Construction Conference.

1.5 SUBSTANTIATING DATA
A. When the Owner requires substantiating information, the Contractor shall submit data justifying line item amounts in question.
B. The Contractor shall provide one (1) copy of data with cover letter for each copy of the submittal. Show application number and date, and line item by number and description.
C. Provide one (1) copy of the latest Construction Schedule, updated to the application date line.

PART 2 – PRODUCTS
Not Used.
PART 3 – EXECUTION
   Not Used.

PART 4 – MEASUREMENT AND PAYMENT
   Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY
This Section covers the procedures for the Contractor to prepare and submit a Schedule of Values (SOV) for a Lump-Sum Contract.

1.2 FORMAT
The Contractor shall provide:
A. The SOV on 8-1/2 inch by 11 inch bond paper, or as otherwise approved, for review by the Owner’s Authorized Representative (OAR).
B. The SOV on the Contractor’s standard forms or may be provided on a computer program-driven printout if approved by the Owner’s Authorized Representative (OAR).

1.3 CONTENT
The Contractor shall:
A. Assign each major item a singular value as a separate line item to serve as a basis for computing values for Progress Payments.
B. Include any Allowances as a separate line item and coordinate the items with the Construction Schedule general activities.
C. List values for the cost of stored products including any taxes paid for items on which payments will be requested for stored products.
D. Ensure the sum of values listed equals the total Contract Amount.

1.4 SUBMITTAL
A. The Contractor shall submit three (3) copies of Schedule of Values at the Pre-Construction Conference.
B. The SOV shall be transmitted under Owner-accepted form transmittal letter identifying the Project by title and number and Contract number.

1.5 SUBSTANTIATING DATA
A. When the OAR requires substantiating information to support the SOV, the Contractor shall submit data justifying line item amounts in question.
B. The Contractor shall provide one (1) copy of data with cover letter for each copy of application. Show application number and date, and line item by number and description.

PART 2 - PRODUCTS
Not Used.

PART 3 – EXECUTION
Not Used.

PART 4 – MEASUREMENT AND PAYMENT
Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY
This Section includes the required forms and schedules necessary to meet the wage rate requirements for the Project.

1.2 FORMS
A. Request for Authorization of Additional Classification and Rate - Standard Form 1444
B. General Wage Decision Rates for Tarrant County, Texas -
   https://www.wdol.gov/dba.aspx

1.3 WAGE RATES
"General Decision Number: TX20190270 10/04/2019
Superseded General Decision Number: TX20180322
State: Texas
Construction Type: Building
County: Tarrant County in Texas.
BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.60 for calendar year 2019 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.60 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2019.

If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually.

Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number    Publication Date
0                       01/04/2019
1                       02/08/2019
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**FOOTNOTES:**

- **A.** 6% under 5 years based on regular hourly rate for all hours worked. 8% over 5 years based on regular hourly rate for all hours worked.


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<td><strong>Rates</strong></td>
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<td>POWER EQUIPMENT OPERATOR</td>
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| (1) Tower Crane............ | $29.00 | 10.60 |
(2) Cranes with Pile Driving or Caisson Attachment and Hydraulic Crane 60 tons and above.....$ 28.75 10.60

(3) Hydraulic cranes 59 Tons and under............$ 27.50 10.60

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<td>PAINTER (Brush, Roller, and Spray (Excludes Drywall) Finishing/Taping))...............$ 16.40 5.45</td>
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* * PLUM0146-003 05/01/2019 |
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<td>DRYWALL HANGER AND METAL STUD INSTALLER</td>
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<td>ELECTRICIAN (Low Voltage Wiring Only)</td>
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<tr>
<td>ELECTRICIAN (Sound and Communication Systems Only)</td>
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<td>ELECTRICIAN, Excludes Low Voltage Wiring and Installation of Alarms/Sound and Communication Systems</td>
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<td>FORM WORKER</td>
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<td>INSTALLER - SIDING METAL/ALUMINUM/VINYL</td>
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<td>IRONWORKER, REINFORCING</td>
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<td>LABORER: Common or General</td>
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<td>LABORER: Mason Tender - Cement/Concrete</td>
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<td>LABORER: Roof Tearoff</td>
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<td>LABORER: Landscape and Irrigation</td>
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<td>OPERATOR: Backhoe/Excavator/Trackhoe</td>
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<td>OPERATOR: Bobcat/Skid Steer/Skid Loader</td>
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<tr>
<td>OPERATOR: Bulldozer</td>
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<tr>
<td>OPERATOR: Drill</td>
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<tr>
<td>OPERATOR: Forklift</td>
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</tbody>
</table>
OPERATOR: Grader/Blade........$ 12.95  0.00
OPERATOR: Loader...............$ 12.89  1.19
OPERATOR: Mechanic.........$ 17.52  3.33
OPERATOR: Paver (Asphalt, Aggregate, and Concrete).........$ 18.44  0.00
OPERATOR: Roller...............$ 15.04  0.00
PIPEFITTER (HVAC Pipe Installation Only)...........$ 21.28  4.45
PLASTERER.........................$ 15.30  0.00
PLUMBER, Excludes HVAC Pipe Installation.................$ 22.10  4.17
ROOFER.................................$ 15.70  0.58
SHEET METAL WORKER (HVAC Duct Installation Only)..............$ 21.54  5.59
SHEET METAL WORKER, Excludes HVAC Duct Installation.............$ 18.63  0.65
SPRINKLER FITTER (Fire Sprinklers).............................$ 19.27  3.68
TILE FINISHER......................$ 11.22  0.00
TILE SETTER.........................$ 12.00  0.00
TRUCK DRIVER: Dump Truck.......$ 12.39  1.18
TRUCK DRIVER: Flatbed Truck....$ 19.65  8.57
TRUCK DRIVER: Semi-Trailer Truck.........................$ 12.50  0.00
TRUCK DRIVER: Water Truck.......$ 12.00  4.11

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist
WAGE RATE REQUIREMENTS
Section: 01 29 85

a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union
average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

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WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination

* a survey underlying a wage determination

* a Wage and Hour Division letter setting forth a position on a wage determination matter

* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations Wage and Hour Division

U.S. Department of Labor

200 Constitution Avenue, N.W.

Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator(See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator

U.S. Department of Labor

200 Constitution Avenue, N.W.

Washington, DC 20210
The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

   Administrative Review Board
   U.S. Department of Labor
   200 Constitution Avenue, N.W.
   Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

PART 2 – PRODUCTS
   Not Used.

PART 3 – EXECUTION
   Not Used.

PART 4 – MEASUREMENT AND PAYMENT
   Not Used.

- END OF SECTION -
**REQUEST FOR AUTHORIZATION OF ADDITIONAL CLASSIFICATION AND RATE**

**Section: 01 29 85.01**

<table>
<thead>
<tr>
<th>CHECK APPROPRIATE BOX</th>
<th>OMB Control Number: 9000-0089</th>
<th>Expiration Date: 10/31/2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERVICE CONTRACT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONSTRUCTION CONTRACT</td>
<td></td>
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</tbody>
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**PAPERWORK REDUCTION ACT STATEMENT:** Public reporting burden for this collection of information is estimated to average .5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspects of this collection of information, including suggestions for reducing this burden, to U.S. General Services Administration, Regulatory Secretariat (MVCSA) 9000-0089, Office of Governmentwide Acquisition Policy, 1800 F Street, NW, Washington, DC 20405.

**INSTRUCTIONS:** THE CONTRACTOR SHALL COMPLETE ITEMS 3 THROUGH 18, KEEP A PENDING COPY, AND SUBMIT THE REQUEST, IN DUPLICATE, TO THE CONTRACTING OFFICER.

1. **TO:**
   - ADMINISTRATOR,
   - WAGE AND HOUR DIVISION
   - U.S. DEPARTMENT OF LABOR
   - WASHINGTON, DC 20210

2. **FROM:** (REPORTING OFFICE)

3. **CONTRACTOR**

4. **DATE OF REQUEST**

5. **CONTRACT NUMBER**

6. **DATE BID OPENED (SEALED BIDDING)**

7. **DATE OF AWARD**

8. **DATE CONTRACT WORK STARTED**

9. **DATE OPTION EXERCISED (IF APPLICABLE) (SERVICE CONTRACT ONLY)**

10. **SUBCONTRACTOR (IF ANY)**

11. **PROJECT AND DESCRIPTION OF WORK (ATTACH ADDITIONAL SHEET IF NEEDED)**

12. **LOCATION (CITY, COUNTY AND STATE)**

13. **IN ORDER TO COMPLETE THE WORK PROVIDED FOR UNDER THE ABOVE CONTRACT, IT IS NECESSARY TO ESTABLISH THE FOLLOWING RATES FOR THE INDICATED CLASSIFICATION(S) NOT INCLUDED IN THE DEPARTMENT OF LABOR DETERMINATION**

   **NUMBER:**

   **DATED:**

   a. **LIST IN ORDER: PROPOSED CLASSIFICATION TITLE(S); JOB DESCRIPTION(S); DUTIES; AND RATIONALE FOR PROPOSED CLASSIFICATION(S). (SERVICE CONTRACTS ONLY)**

   (Use reverse to attach additional sheets, if necessary)

   b. **WAGE RATE(S)**

   c. **FRINGE BENEFITS**

   d. **PAYMENT**

14. **SIGNATURE AND TITLE OF SUBCONTRACTOR REPRESENTATIVE (IF ANY)**

15. **SIGNATURE AND TITLE OF PRIME CONTRACTOR REPRESENTATIVE**

16. **SIGNATURE OF EMPLOYEE OR REPRESENTATIVE**

   **TITLE**

   **CHECK APPROPRIATE BOX: REFERENCING BLOCK 15.**

   - [ ] AGREE
   - [ ] DISAGREE

**TO BE COMPLETED BY CONTRACTING OFFICER (CHECK AS APPROPRIATE - SEE FAR 22.1019 (SERVICE CONTRACT LABOR STANDARDS) OR FAR 22.406-3 (CONSTRUCTION WAGE RATE REQUIREMENTS))**

- THE INTERESTED PARTIES AGREE AND THE CONTRACTING OFFICER RECOMMENDS APPROVAL BY THE WAGE AND HOUR DIVISION. AVAILABLE INFORMATION AND RECOMMENDATIONS ARE ATTACHED.

- THE INTERESTED PARTIES CANNOT AGREE ON THE PROPOSED CLASSIFICATION AND WAGE RATE. A DETERMINATION OF THE QUESTION BY THE WAGE AND HOUR DIVISION IS THEREFORE REQUESTED. AVAILABLE INFORMATION AND RECOMMENDATIONS ARE ATTACHED.

**SIGNATURE OF CONTRACTING OFFICER OR REPRESENTATIVE**

**TITLE AND COMMERCIAL TELEPHONE NUMBER**

**DATE SUBMITTED**

**PREVIOUS EDITION IS USABLE**

**STANDARD FORM 1444 (REV. 4/2013)**

Prescribed by GSA-FAR (49 CFR 63.2220f)

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Dallas Fort Worth International Airport

Request for Authorization of Additional Classification and Rate

Publish Date: December 7, 2018

01 29 85.01 - 1
PART 1 - GENERAL

1.1 SUMMARY

A. This Section covers the requirements and procedures if Allowances are included in the Contract.

B. Allowances are not included in the Lump Sum Base Bid for a Lump Sum contract.

C. Allowances have been set aside to complete elements of the Work that are within the general scope of work, but are not shown on the Plans or specified in the Specifications. Any and all unused portions of the stipulated Allowances will not be paid to the Contractor and shall be deducted from the Contract Amount at the Final Completion of the Project.

D. Use of any funds allotted to Allowances is only for the Work of the Project. While Allowances are considered to be within the original Scope of Work, such items could not have been reasonably anticipated based upon the information available at the time the cost estimate was established. Use of such funds is not to be construed as including upgrading or enlarging the Scope of Work of the Project and its use is at the sole discretion of the Owner.

E. All price quotes and scopes of work requested by the Owner through the Owner’s Authorized Representative (OAR) for each Allowance item of work, shall be provided to and approved by the OAR prior to the Contractor proceeding with any such work. The Contractor shall provide a price quote within seven (7) Calendar Days of receipt of request by the OAR.

F. The OAR will approve an Allowance item of work by issuance of a Change Order prior to the Contractor proceeding with such work. The Change Order will clearly define the Allowance item scope and agreed to pay amount.

G. Contract Time extensions may not be executed under this process, but within the Change Order process. Any adjustment to the Contract Time shall be in accordance with Section 01 32 16, Construction Progress Schedule.

1.2 ALLOWANCE SCOPE

A. Standby Time: This Allowance establishes means to compensate the Contractor for temporary disruptions to his work resulting from ramp operations. Any compensable disruptions, further identified as Standby Time, must be approved by the Owner through the OAR.

B. Differing Site Conditions: This Allowance establishes means to compensate the Contractor for changes in the Scope of Work as directed by the OAR to mitigate differing or unforeseen field conditions. The scope and associated compensation under this Allowance includes, but is not limited to:
   1. Additional demolition, relocation, or modification of existing infrastructure to mitigate miscellaneous unforeseen conditions.
   2. Additional demolition, relocation or modification of existing utilities and MEP systems.

C. Unforeseen Hazardous Materials Remediation: This allowance is to account for the proper removal of hazardous materials encountered during excavation and construction activities. The scope of work and associated compensation under this
allowance includes, but is not limited to: protection of potential hazardous materials discovered during construction, acquiring services of a properly qualified contractor to fully expose, remove, transport, and dispose of the hazardous materials at an approved disposal facility, and any special handling or construction activities necessary to accommodate the hazardous materials removal.

D. Supplemental Safety Measures: This allowance is to account for all labor, equipment and material as may be required to procure, place, remove and/or modify the construction safety plan as it relates to all works above the existing ceiling and mezzanine level for demolition, relocation and new installation, temporary fencing, and other miscellaneous items deemed necessary by the Airport for the proper protection of the building occupants and airport personnel.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Price quote and scope of work requested by the OAR for each Allowance item, shall be provided to and approved by the OAR prior to the Contractor proceeding with such work.

4.2 PAYMENT

Payment will be made under:

Pay Item 01 30 00-1 Standby Time
Pay Item 01 30 00-2 Unforeseen Field Conditions
Pay Item 01 30 00-3 Unforeseen Hazardous Materials Remediation
Pay Item 01 30 00-4 Supplemental Safety Measures

– END OF SECTION –
PART 1 – GENERAL

1.1 This Section includes the Contractor participation in the following conferences and meetings required for the Project:

A. Pre-Construction Conference
B. Site Mobilization Conference
C. Progress Meetings

1.2 PRE-CONSTRUCTION CONFERENCE

A. The Contract Administrator will schedule the “Pre-Construction Conference” after the Notice to Proceed (NTP) has been issued.

B. Attendance: Contract Administrator, Owner’s Authorized Representative (OAR), Architect/Engineer, Business Diversity and Development Department (BDD), other Airport departments represented as required, and the Contractor.

C. Agenda:

1. Purpose of the meeting
2. Brief Project description
3. Project duration and milestones
4. Introduction and explanation of functions of the Airport, the Airport personnel and organization (including responsibilities and authority)
5. Owner requirements
   a. Wage and Hour Rate
   b. Payroll audits
   c. S/D/M/WBE Goals
   d. Pay Estimate Forms, Procedures and Applications
   e. Field Alteration Forms and Procedures
   f. Security Badge Procedures
   g. Other Security Procedures
   h. Project Safety
   i. Project Safety Plan

6. Project Control Procedures
   a. Project Meetings
   b. Construction Schedules
   c. Major Equipment Deliveries and Priorities
   d. Submittals
   e. Alternates/Substitutions
   f. Utilities
   g. Contractor’s Quality Control Plan
h. Security and Housekeeping
i. Maintenance and Protection of Vehicular and Pedestrian Traffic
j. Coordination of the Work

7. Construction Management Procedures
   a. Permits
   b. Correspondence and Documentation
   c. Processing of a Request for Information (RFI)
   d. Processing of Non-Conformance Report (NCR)
   e. Coordination of Project Work with adjacent projects
   f. Monthly Progress Photographs and Videos
   g. Environmental Concerns and Drainage Control
   h. Contract Modification and Claim Procedures
   i. Completion of the Work and Punch List procedures
   j. Record Drawings
   k. Final payment and Closeout Procedures

1.3 SITE MOBILIZATION CONFERENCE

A. The OAR will schedule a conference at the Project site prior to Contractor occupancy.

B. Attendance: OAR, Architect/Engineer, Contractor, and major Subcontractors.

C. Agenda:
   A standard agenda for the Project shall be determined based on the Project type. The standard agenda shall be coordinated between the Contractor’s Authorized Representative (CAR) and the OAR at least one (1) week prior to the first meeting. A sample of a standard agenda for an airfield project follows:
   1. Roadways use by the Owner’s personnel, OAR, and Contractor
   2. Roadway closing
   3. Transporting equipment
   4. Temporary utilities
   5. Schedules
   6. Procedures for maintaining record documents
   7. Requirements for start-up of equipment
   8. Inspection and acceptance of equipment put into service during construction period

1.4 PROGRESS MEETINGS

A. Project Meetings will be scheduled weekly to monitor the progress of the Work.
B. The OAR will be responsible for physical arrangements for meetings; prepare agenda with copies for participants.

C. The OAR will preside at these meetings; record minutes, and will prepare and distribute copies of minutes.

D. Attendance: Contractor’s Authorized Representative (CAR), major subcontractors and suppliers, Architect/Engineer as appropriate to agenda topics for each meeting.

E. Meeting Agenda:
   1. Review Previous Meeting Minutes
   2. Safety
   3. Schedule (3 Week Look Ahead, Pre-Activity Meetings, Work Progress, Work Status)
   4. Davis-Bacon (if applicable)
   5. Submittals
   6. Requests for Information
   7. Non-Conformance Reports
   8. QA/QC
   9. Environment/Erosion Control/Utilities
   10. Correspondence
   11. Changes & Revisions (Pending CO, Potential CO, Problems)
   12. Application for Payment
   13. Airport Operations
   14. Code/Commissioning
   15. Other Business

PART 2 – PRODUCTS
   Not Used.

PART 3 – EXECUTION
   Not Used.

PART 4 – MEASUREMENT AND PAYMENT
   Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY
A. This Section includes the administrative and procedural requirements for schedules and reports required for proper performance of the Work.

B. A Construction Schedule shall be prepared and submitted by the Contractor for approval of the Owner’s Authorized Representative (OAR) prior to the Contractor commencing with any construction activities.

1.2 REQUIREMENTS
A. The Contractor shall prepare and maintain a Construction Schedule in accordance with the requirements of this Section. The requirement for a Construction Schedule is included to:
   1. Assure adequate planning and execution of the Work by the Contractor.
   2. Assure coordination of the Work of the Contractor with other contractors, subcontractors and suppliers.
   3. Incorporate proper coordination of the Work between Owner and the airlines/tenants.
   4. Assist the Contractor and the OAR in evaluating:
      a. Contract performance relative to the Milestones included in the Project Schedule as referenced in Section 01 11 00 - Summary of Work.
      b. Monthly progress
      c. Proposed Contract modifications

B. The Construction Schedule shall include:
   1. Detailed Critical Path Method (CPM) Diagram of all Project activities, including procurement and delivery of major deliverables or field equipment, and subcontractor schedules.
   2. Work Breakdown Structure (WBS) as defined by the Project’s Scope of Work
   3. Respective WBS assignment for each Activity
   4. Summary Bar Chart-(Gantt Chart)
   5. Resource & cost loading – Refer to subsection 1.3.D for requirements.

The schedule cost loading must include the following:
   a. Budgeted Cost
   b. Cost to Date
   c. (S-Curve) graphical report including: Contract amount line, Baseline curve, Milestone markers, Work-in-Progress, ETC Curve, EAC line.

The schedule resource loading must include identification of D/S/M/WBE contractors based on the contract commitment in Special Provisions Section 2.0 and as approved by Business Development & Diversity Department (BDDD).
a. Budgeted Cost associated with the D/S/M/WBE resource must be provided.

6. Planned cash flows based on early and late activity dates. Bi-weekly graphical reporting of Earned Value Cost actual cashflow vs. baseline plan.

7. Responsibility Code by Company

C. The Contractor shall provide a Construction Schedule suitable for planning, scheduling and reporting the Work to be performed under the Contract. The Construction Schedule shall be developed using the Owner’s approved project planning software, Oracle-Primavera P6 (current version) as updated by Oracle (Primavera) throughout the Project. Other Primavera P6 versions that are fully compatible with the current version, or other schedule software, may be acceptable if approved by the OAR.


Acceptance of the planning software and version by the OAR shall be used for the Baseline Schedule, Construction Schedule, and any updates throughout the Project, unless a new planning software version is approved by the OAR.

D. The Construction Schedule shall be resource & cost loaded at the WBS Summary Level if the period of Work from the Notice to Proceed (NTP) to Substantial Completion exceeds 12 months, or if the Contract Amount exceeds $2.0 Million, or upon written notice by the OAR based on necessity to evaluate the Construction Schedule performance regardless of whether the above limits apply.

1. Cost can be loaded as either a lump sum non labor resource or a price per unit labor/material resource as appropriate and agreed upon by the OAR.

2. The cost shall be broken down to align with the WBS level and loaded to match the Contract Items or Schedule of Values (SOV) breakdown/milestone payments, as appropriate, for the Contract.

3. Mobilization shall be loaded across a Level of Effort (LOE) activity and invoiced as required in Section 01 71 13.

4. Period Cost and Cost to Date shall be coordinated between consecutive Payment Applications and the construction activity progress.

5. Cumulative amount of cost loaded Work activities shall equal total Contract Amount.

6. Change Orders, including changes that are addressed using one or more Allowances, shall be added to the Construction Schedule and Cost Loaded with corresponding cost, activity description, and logic. An updated CPM Diagram, Gantt Chart and S-Curve must be submitted with all Change Order requests and will include the impact of each request.
7. Notwithstanding paragraph D above, all schedules must include the D/S/M/WBE resource based on the contract commitment in Special Provisions Section 2.0 and as approved by BDDD and must include the associated cost.

8. The Contractor shall include additional cost breakdown or information requested by the OAR at no additional cost.

9. Refer to subsection 1.7.D.5.c for additional reporting requirements.

E. The Construction Schedule shall, at a minimum, adhere to industry standards for scheduling of activities maximum durations, use of open ended activities, the percentage of logic types, the use of constraints and their type, and the use of activity leads and lags, etc.

F. The Contractor shall use the following Planning Schedule Logic:
   1. Calculate Start-to-Start lag from Early Start.
   2. Calculate the schedule using the Retained Logic scheduling option.
   3. Define Critical Activities as; Total Float less than or equal to zero.
   4. Show Open-Ends as Non-Critical.
   5. Calculate Total Float as Late Finish – Early Finish.
   6. Calendar for scheduling shall be 7 days/week with no holidays considered.
   7. The use of Terminal Float or Buffering Activities within the Construction Schedule shall not constitute Ownership of that Float by the Contractor.

G. The Contractor shall use assign Activity Assignments to the following:
   1. Duration type is Fixed Duration and Units.
   2. Activity % Complete Type should be as Physical.
   3. Activity Type should be Task Dependent for “working” activities.

H. The Contractor shall use the following Project Calculation and Settings:
   1. Link Actual to Date and Actual this Period.
   2. Link Budget and Estimate to Completion (ETC) for non-progressed activities.

I. Schedule Detail shall be broken down such that the Activity Duration is no longer than 14 Calendar Days and no activity shall exceed 30 Calendar Days without the consent of the OAR.

J. Activity Descriptions shall be unique and follow the naming convention of “LOCATION – VERB NOUN”. That is: a common Location ID followed by an action verb (i.e. DEMO, INSTALL, SET, etc.), followed by the item name (noun) requiring action.

K. Summary Bar Chart (Gantt Chart)
   1. The Summary Bar Chart shall be based on the activity durations and logic indicated in the CPM Diagram area of the schedule.
   2. The Contractor and the OAR shall jointly select Summary Level activities.
   3. Each Summary Level activity shall include:
      a. A concise description of the Work represented by the activity
b. A Time Bar indicating planned/actual Activity Start and Activity Finish dates and actual Cumulative Percent Complete at the end of each reporting period.

c. A status line as of the end of the reporting period. (Data Date)

d. Major procurement items required to support the summary activity duration.

4. The Summary Bar Chart shall display all Contract milestones.

L. Seasonal weather conditions shall be considered and included in planning and scheduling via a “weather calendar” assigned to such affected activities for all work influenced by high or low ambient temperatures, precipitation and/or saturated soil to ensure completion of all Work within the Contract Time.

Contract Time extensions for abnormal weather will be granted in accordance with subsection 1.10 only to the extent that the actual time lost during a particular month exceeds the average lost time indicated in the General Provisions, Section 80, Prosecution and Progress. Contract Time extensions granted for abnormal weather are not compensable.

M. The Contractor shall not use the following types of logic relationships:

1. Negative lags
2. Positive lag in excess of ten (10) work days
3. Start-to-Finish relationships
4. Open ends.
   Only the first activity will have no predecessor and only the last activity will have no successor.

5. Constraints.
   The Contractor may use a limited number of constraints. An appropriate number of constraints is at the sole discretion of the Owner and will be established during Baseline Schedule submission/acceptance.

1.3 Not Used

1.4 SCHEDULE REPRESENTATIVE

A. Within seven (7) Calendar Days after receipt of the NTP, the Contractor shall designate in writing a schedule representative in the Contractor’s organization who shall be responsible for coordinating with the OAR during preparation and maintenance of the Schedule.

B. The Contractor’s schedule representative shall have complete authority to act for the Contractor in fulfilling the Schedule requirements of the Contract, and if such authority is interrupted during the Contract it shall be obtained in writing by the OAR. This schedule representative cannot be replaced without the approval of the OAR.

1.5 BASELINE SCHEDULE

A. The Contractor and major Subcontractors shall meet with the OAR immediately after the issuance of the NTP to jointly agree on guidelines, WBS, level of detail and summaries to be used in developing the Baseline Schedule. The Contractor must prepare a interim Baseline Schedule for this meeting showing in detail the activities
to be accomplished during the entire Project. The interim Baseline Schedule will become the final Baseline Schedule upon approval of the OAR and shall not be revised for the remainder of the Project.

B. The Baseline Schedule needs to include reasonable operational, seasonal, economic, weather, facility or manpower restrictions required for sequencing of Work.

C. The Contractor shall be responsible for assuring all work sequences are logical and the Baseline Schedule 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 Baseline Schedule shall not excuse the Contractor from completing all Work within the Contract Time.

D. The Baseline Schedule shall comply with the various limits imposed by the Contract Documents and by any contractually specified intermediate milestone dates and completion dates.

E. The degree of detail shall be to the satisfaction of the OAR and shall be sufficient to identify:
   1. The Work Breakdown Structure of the Project.
   2. Contract Milestones and phasing.
   3. The types of work to be performed by subcontractor and labor trades involved including the respective quantities and durations required for timely prosecution of stated work.
   4. The D/S/M/WBE contractors based on the contract commitment as approved by BDDD.
   5. Submittal review, procurement, fabrication, delivery, installation and testing of major materials and equipment.
   6. Access and availability to work areas.
   7. Manpower, material, space, and equipment constraints.
   8. Delivery of Owner-furnished equipment as applicable.
   9. Interfaces and dependencies with preceding, concurrent and following contractors.
   10. Cash flow curves showing the planned cash flow at each Payment Application including the cumulative cash flow for the Contract.

F. The Contractor shall submit the Baseline Schedule to the OAR and/or upload the Baseline Schedule into the Owner’s database as directed by the OAR.

1.6 ROLLING THREE WEEK LOOK AHEAD SCHEDULES

A. A Rolling Three Week Look Ahead Schedule shall be submitted weekly and shall be the basis of the weekly Progress Meetings.

B. The Rolling Three Week Look Ahead Schedule shall be the actual detailed work plan used by the Contractor in meeting the Project Schedule and Milestones.

C. The basis of the Rolling Three Week Look Ahead Schedule shall be the updated Construction Schedule.
D. The Rolling Three Week Look Ahead Schedule shall display at minimum:
1. Activity ID & Description.
2. Planned Activity Expected Duration and representative Dates.
3. Physical Percent Complete.
4. Activities or data for the previous week, current week, the and next two (2) following weeks.
5. Indicator for Action Items that require resolution before execution of the Activity can occur.
6. Indicator of all Critical Path activities with Total Float.
7. Main/Immediate Milestones Status (Plan/Forecast).
8. Any additional information the Contractor wishes to include information to assist in the organization and understanding of the selected Activities.

E. The Contractor shall prepare a written narrative status report of the project progress and key forecasted activity starts or completions or any anticipated issues to accompany the Rolling Three Week Look Ahead Schedule. The reports shall be submitted to the Project Manager as part of the weekly Contractor meetings. Written status reports shall include but are not limited to:
2. Progress made on critical activities indicated on the Construction Schedule.
3. Explanations for any lack of work on critical path activities planned to be performed during last week and a recovery plan of how the project will be brought back on schedule.
4. Explanations for any proposed schedule changes, including changes to logic or to activity durations.
5. Status of major material and equipment procurement.
6. Any delays encountered or expected during reporting period and upcoming reporting periods. Delays involving D/S/M/WBE contractors should be specifically addressed.
7. Any changes in the planned early and late cash flow curves.

1.7 BI-WEEKLY (every other week) PROJECT STATUS REPORTING AND UPDATING

A. After the Baseline Schedule is approved, the Construction Schedule shall be updated bi-weekly until Final Completion. Entering of actual progress made through the end of the reporting period, including actual dates activities started and/or completed, the percentage of work completed, Payment Application amounts, and estimated remaining duration for each activity in progress will be subject to approval of the OAR. If requested by the OAR, the Contractor shall participate in pre-update conferences to verify progress and review modifications to the Construction Schedule prior to the formal submittal.

B. In case of disagreements concerning actual progress to date, the OAR’s determination shall govern.
C. The Contractor shall update the Construction Schedule to reflect period and cumulative progress, and reflect any approved schedule revisions.

D. The updated Construction Schedule shall be submitted and entered into the Owner’s database within three (3) Calendar Days of the Construction Schedule status date, and with the corresponding Payment Application and early/late/actual cash flow curves, and shall include the following:

1. A PDF file (.pdf) of the complete Construction Schedule sorted Early Start, Total Float, then by Remaining Duration and shall identify the following:
   a. Activity Identification
   b. Activity Description
   c. Original Duration
   d. Remaining Duration (based on an estimate of the actual days remaining to complete the activity and not the quantity survey percent complete)
   e. BL Start Date or Actual Start Date
   f. BL Finish Date or Actual Finish Date
   g. Total Float
   h. Variance from BL (baseline)

2. If required by the OAR, a PDF of the 90-day Look Ahead grouped by WBS Sorted by Early Start, Total Float, then by Remaining Duration.

3. If required by the OAR, a PDF of the 90-day Look Ahead Grouped by Responsibility Code (with page breaks), Sorted by Early Start, Total Float, then by Remaining Duration.

4. A copy of the Contractor’s updated Primavera P6 .xer file, unless other OAR approved software is being used, and then the data shall be transmitted electronically in a format compatible with the current version of Primavera.

5. A narrative report:
   a. The Contractor shall explain all progress made during the period.
   b. Status of critical Project components (percent complete, amount of time ahead or behind schedule) and an explanation of Corrective Actions taken or proposed to bring the Project back on schedule if delays have occurred.
   c. The Contractor shall include a schedule analysis along with calculations. The following is a minimum analysis to be reported: (Refer to subsection 1.2.D to determine if required).
      1. Earned Value at the Project Summary Level
      2. EV to Pay Application Request Variance
      3. Cash Flow Variance
      4. Estimated at Completion (EAC)
      5. Estimate to Completion (ETC)
      6. Current and projected schedule Variance
7. Cost Variance
   d. Updates for the forthcoming report period.
   e. Status of major material and equipment procurement.
   f. Mitigation measures on all negative variances.
   g. Delaying factors / problem areas, current and anticipated.
   h. Identify known current and or potential risks and detail mitigation options for each.
   i. Identify and provide explanations for all schedule changes, including changes to logic or to activity durations.
   j. Explanations for any lack of work on Critical Path activities planned to be performed during the last period.
   k. Identify any changes to the Critical Path and the drivers for them.
   l. Report indicating actual versus planned resource loading for each trade and each activity.
   m. Any variances related to D/S/M/WBE contractors should be specifically addressed.
   n. The Contractor may include any other information pertinent to status of project.
   o. The Contractor shall include additional status information requested by the OAR at no additional cost.

E. Status reports, and the information contained therein, shall not be construed as claims, notice of claims, notice of delay, or requests for changes or compensation. Refer to the requirements in the General Provisions and Special Provisions of the Contract to address these matters.

F. If the Contractor’s update of the Construction Schedule reflects, or OAR determines, that the Contractor is at least ten percent (10%) or fifteen (15) or more Calendar Days behind the approved Baseline Schedule for any of the Project interim or completion milestones, then the Contractor shall submit a Recovery Schedule. A Recovery Schedule shall be submitted separate from the update of the Construction Schedule within seven (7) Calendar Days of identification of a recovery condition or upon receipt of a written request from the OAR.

1.8 SCHEDULE REVIEW AND APPROVAL

A. The OAR and the Contractor shall meet within five (5) Working Days of receipt of the interim Baseline Schedule for joint review of the proposed interim Baseline Schedule. The Contractor shall revise any areas which, in the opinion of the OAR, conflict with either the intent of this Section or the timely completion of the Project.

B. If the Contractor fails to define any element of work activity or logic currently designed and the OAR review does not detect this omission or error, such omission or error shall be corrected by the Contractor with the Baseline Schedule or the next update to the Construction Schedule.

C. The Contractor shall revise the interim Baseline Schedule in accordance with agreements reached during the joint review meeting of the interim Baseline
Schedule. The final Baseline Schedule shall be submitted in the same form and detail as the interim Baseline Schedule.

D. Approval of the Baseline Schedule will be a condition precedent to any Progress Payment under the Contract.

1. All or part of any Progress Payment may be withheld for work performed prior to the approval of the Baseline Schedule. Approval of the Baseline Schedule will not be unreasonably withheld.

2. All or part of any Progress Payment may be withheld for work performed during the subsequent progress periods without acceptance of the respective update to the Construction Schedule. Acceptance of any update to the Construction Schedule will not be unreasonably withheld.

3. Acceptance of approval of the Baseline Schedule by the OAR does not relieve the Contractor of any of its responsibility for the accuracy or feasibility of the Baseline Schedule; however, to the extent that the approved Baseline Schedule is reasonable, it shall become a part of this Contract and defines the obligations of both the Contractor and the Owner to achieve a timely contract completion.

4. If the approved Baseline Schedule indicates the Contractor's Finish Date will be prior to Final Completion, the Contractor and the Owner may execute a Change Order adjusting the Final Completion to coincide with the Contractor's planned Finish Date at no expense to the Owner.

1.9 CONSTRUCTION SCHEDULE REVISIONS

A. The update to the Construction Schedule to reflect Actual Progress to Date shall not be considered a revision of the Construction Schedule. All schedule revisions must follow the process prescribed for Contract changes in the General Provisions.

B. The Contractor shall revise the Construction Schedule when one or more of the following conditions occur:

1. When a change or delay significantly affects any specified intermediate milestone dates or completion dates.

2. When the Contractor elects to change any sequence of activities affecting the Critical Path or to significantly change the previously approved Baseline Schedule logic.

3. When the Contractor has received written approval from BDDD to add, remove or replace a D/S/M/WBE Contractor.

4. When, in the opinion of the OAR, the Construction Schedule and supporting analysis is no longer representative for planning and evaluation of the Work.

C. Submit any revision to the Construction Schedule in the same form and detail as the approved Baseline Schedule.

D. The OAR must approve any revision to the Construction Schedule.

1.10 TIME IMPACT ANALYSIS FOR CONTRACT MODIFICATIONS, DELAYS, AND TIME EXTENSIONS

A. When changes to the Contract are initiated or delays are experienced, the Contractor shall submit to the OAR a written Time Impact Analysis (TIA) illustrating the influence
of each change or delay on any specified intermediate Milestone and the current projected completion date.

1. The Contractor, as required by the General Provisions and Special Provisions of the Contract, shall notify the OAR of a change that may impact an intermediate Milestone or Final Completion.

2. Calendar for Time Impact shall be 7 days/week with no holidays considered.

3. Each TIA shall include a fragmentary network (fragnet) indicating all necessary logic, duration of impact, D/S/M/WBE resources affected, and demonstrate how the Contractor proposes to incorporate the change or delay into the current approved Construction Schedule.

4. The event times used in the TIA shall be those included in the latest update of the detailed progress schedule or as adjusted by mutual agreement to reflect project status at the time the delay occurred or notification of the change was issued.

5. The TIA should include any additional supporting evidence that the OAR deems necessary.

6. A .pdf copy of the TIA shall be submitted and entered into the Owner’s document control system or as otherwise directed by the OAR.

7. A Primavera P6 .xer of the Construction Schedule representing the impact calculations shall be submitted to the OAR.

8. A narrative in the same form and detail as the Construction Schedule update identifying all steps taken to calculate the impact and Recovery Schedule, shall be submitted to the OAR for review and acceptance.

9. Upon agreement by the Contractor and the OAR, the influence of changes and delays shall be incorporated into the next update of the Construction Schedule.

10. Where the OAR has not completed a determination of any Contract Time extension, or the OAR and Contractor are unable to agree as to the Contract Time extension due, the Contractor shall reflect that amount of time extension in the update to the Construction Schedule as the OAR may determine to be appropriate for such interim purpose. It is understood and agreed that any such interim determination shall not be binding upon either party for any other purpose and that, after the OAR has determined any Contract Time extension, the Contractor shall revise the update(s) to the Construction Schedule prepared thereafter in accordance with the final determination.

11. It is understood and agreed that schedule Float time is not for the exclusive use of either the Owner or the Contractor. Extensions of Contract Time for performance under any and all of the provisions of this Contract will be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the Total Float along the channels involved at the time a delay occurred or notification of a change was issued. It is expressly agreed and understood that the Contractor shall not be entitled to any compensation or damages on account of potential delays which can be avoided by re-sequencing activity times or logic used to sequester the available Float.

12. TIA related to a Contract Time extension and/or changed work shall be incorporated into and attached to the applicable Contract Change Order.
1.11 RESPONSIBILITY FOR COMPLETION

A. The Contractor shall furnish sufficient forces, offices, facilities and equipment, and shall work such hours including night shift and overtime operations, as necessary to ensure the prosecution of the Work. If, in the opinion of the OAR, the Contractor, due to its own action, falls behind in meeting the Construction Schedule, the Contractor shall take such steps as may be necessary to improve its progress, and the OAR may require the Contractor to increase the hours of work, the number of shifts, the amount of supervision, overtime operations and/or the amount of construction plant and equipment without additional cost to the Owner. The provisions of this Section shall not be construed as prohibiting work on Saturdays, Sundays, and/or holidays, if the Contractor so elects and gives reasonable notice to the OAR. Work hours shall conform to Section 01 11 00, Summary of Work, and the Plans.

B. The Contractor may improve its progress by performing sequential activities concurrently, by performing activities more quickly than planned, or by revising the logic within the Construction Schedule to reflect a work around sequence. The Contractor may make minor logic changes, which are required to reflect actual work as it is performed, pertaining to out-of-sequence work. The minor logic changes shall be included in the schedule narrative and incorporated into the Construction Schedule in the approved format.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION –
PART 1 – GENERAL

1.1 SUMMARY

This Section includes the administrative and procedural requirements for submittal of shop drawings, coordination drawings, product data and samples, to verify that products, materials, and systems proposed for use comply with provisions of the Contract Documents.

1.2 SHOP DRAWINGS

A. Shop Drawing Requirements:

1. Present drawings in a clear and thorough manner. Title each drawing with the Contract name and number; identify each element of the shop drawings by reference to sheet number and detail, schedule, or room number shown on the Plans.

2. Briefly and clearly identify field dimensions and field conditions; show relation to critical features, work, or adjacent products as applicable.

3. Shop drawings shall be of size and scale appropriate for their purpose and insofar as possible shall be uniform in size.

4. Shop drawings shall show design, materials (kind, thickness and finish), dimensions, connections, and other details necessary to ensure that they accurately interpret the Plans and Specifications, including adjoining work, in such detail as required to provide proper connection with the existing or adjoining work. Shop drawings shall not be reproductions of the Plans.

5. Shop drawings shall be numbered consecutively. Retain the numbering system throughout revisions.

6. Identification: All Shop drawings shall be identified with the Project name, building, or buildings for which shop drawings are being submitted. The Project name and Owner’s Contract Number, Contractor’s name, Subcontractor’s name, date of submittal, drawing number, revision number, date of each revisions if any, as well as the Specification under which the work is to be performed and the drawing and detail numbers shown in the Plans that relate to the shop drawings.

7. Check and coordinate shop drawings of section or trade with requirements of other sections or trades as related and as required for proper and complete installation of the work.

B. Shop Drawings Submittal Procedures:

The Contractor shall submit shop drawings using the Skire Unifier software application or as otherwise directed by the Owner’s Authorized Representative (OAR).

1.3 PRODUCT DATA

A. Product Data Requirements:

1. All product data in the form of manufacturer standard drawings, certificates, reports, catalog cuts, brochures, etc. shall be uploaded using the Skire Unifier software application or as otherwise directed by the OAR.
2. All product data shall be clearly labeled to identify pertinent products or models.

3. Product information shall show performance characteristics and capacities, dimensions and clearances as required, applicable wiring and piping diagrams and controls; and the specified finish.

4. Product data in the form of a manufacturer’s standard schematic drawings and diagrams shall be modified to delete information which is not applicable to the Work and should be supplemented to provide information specifically applicable to the Work.

B. Product Data Submittal Procedures:

1. Product Data, Certificates, and Reports shall be submitted using the Skire Unifier software application or as otherwise directed by the OAR.

1.4 SAMPLES

A. Sample Requirements:

1. Samples shall be submitted from the same source, which will supply the actual product on the Project. Provide samples of sufficient size to clearly illustrate quality, functional, finish characteristics of product, with integrally related parts and attachment devices and full range of color, texture and pattern. In no case shall the sample be less than 4 inches x 4 inches.

2. Where possible, all samples required for a particular Specification Section shall be submitted together. Manufactured products that generally degrade with time such as rubber, plastic, etc. shall have a production / assembly date of no more than 18 months prior to installation / assembly on the Project.

3. In the event that a range of variations in texture, graining, color or other characteristics may be anticipated in furnished materials, assemblies, or elements of the Work, a sufficient number of samples of such materials or products shall be submitted to indicate the full range of characteristics which will be present in the materials or products proposed for the Work. Any such materials or products delivered or erected prior to approval of full range samples shall be subject to rejection by the OAR.

4. Samples of materials or products, which are normally furnished in containers or packages, which bear descriptive labels or application or installation instructions, shall be submitted with such labels or instructions.

5. Identification: All samples shall be labeled, tagged, or otherwise clearly identified. Labels or tags shall set forth the Project name, building or buildings for which the sample is being submitted, Contractor, Subcontractor, supplier, the name of the manufacturer, fabricator, or processor, the trade designation, grade and quality of the material or product, the date of submittal, and specific identification of each sample and a precise reference to the Specification Section and paragraph in which the material, product, or element of the Work is specified. Each label or tag shall have sufficient clear space to permit the application of the approval stamps of the Contractor and the OAR or the Architect/Engineer as required.

6. Where appropriate, test data or manufacturers’ certificates shall be referenced in and forwarded with the letter of transmittal. Samples without accompanying certificates or test data will be returned without action.
B. Samples Submittal Procedure

1. The Contractor shall submit at least three (3) sets of each sample required to the Field Office or a site designated by the OAR. Submit one (1) additional sample for civil, landscape, structural, mechanical, electrical, baggage handling systems, and security/information technology/communications systems work.

2. Upon completion of review, the OAR will return one (1) sample of each set of samples to the Contractor.

3. Project Record Document Samples:
   a. Items requiring submittal for color, texture or finish selection shall be included in Record Document Finish Manual in accordance with Section 01 78 39.
   b. A sample of selected color, texture or finish shall be provided on sample chip at least 4 inches x 4 inches, suitable for adhering to cardboard page in Record Document Finish Manual.
   c. Record sample shall match actual material installed.
   d. The Contractor shall prepare record samples, assemble on pages, and submit in accordance with Section 01 78 39.
   e. The Contractor shall submit two (2) copies of the Record Document Finish Manual.

1.5 OWNER REVIEW

A. The OAR or the Architect/Engineer will review the Contractor’s submittal such as shop drawings, product data and samples, for conformance with the design, intent, and Specifications. During this phase, the OAR or the Architect/Engineer shall review and provide appropriate action code response or take other appropriate action on the submittal and return the reviewed submittal to the Contractor within 14 Calendar Days of receipt. Depending upon the complexity of the submittal, amount of review required, and number of concurrent submittals, the OAR will attempt to return submittals within shorter time frames whenever possible.

B. The Contractor shall submit shop drawings, products data, and samples sufficiently in advance of scheduled installation dates to allow for the 14 Calendar Day review period, including consideration for the possibility of submittal rejection.

C. All submittals will be tracked by the OAR using the Skire Unifier software application or other tracking mechanism as required.

D. The OAR or Architect/Engineer review of any submittal will be for conformance with the Plans and Specifications. The Contractor shall be solely responsible for confirmation of dimensions and correlated at job site; information pertaining to the fabrication process or to techniques of construction; and for coordination of the Work for all trades.

E. Contractor's Responsibility:

1. Any acceptance or other response of shop drawings, product data or samples shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has informed the OAR or Architect/Engineer, in writing, of such deviation at the time of submission and approval has been given within the Skire Unifier software.
application to the specific deviation. Similarly, any approval or other response shall not relieve the Contractor from such responsibility for errors or omissions in the shop drawings, product data, or samples.

2. Any acceptance or other response of shop drawings and product data shall not relieve the Contractor of any responsibility, including responsibility for accuracy of dimensions and details, and for conformity of its drawings with the Plans and Specifications.

3. The Contractor shall review all submittals for completeness, accuracy, and format concurrence with the Plans and Specifications prior to forwarding the submittal.

F. Reviewer's Distribution and Approval:

Following the OAR or Architect/Engineer's review of each submittal, comments and/or approval the submittal will be provided using the Skire Unifier software application.

G. Contractor's Distribution:

The Contractor shall distribute approved submittals using the Skire Unifier software application.

1.6 COORDINATION DRAWINGS

A. Coordination of Drawing Submittal Procedures:

1. Coordination drawings for each work area shall be submitted and approved before shop drawings are submitted. Shop Drawings submitted before coordination drawings have been approved will be returned without comment and marked “NOT ACCEPTED”. Any resulting delays will be the responsibility of the Contractor.

2. Prepare coordination drawings to indicate how work shown by separate civil, structural, mechanical, electrical, baggage handling system, security/information technology/communications systems shop drawings shall be interfaced, intermeshed and sequenced for installation.

3. A minimum of three (3) weeks before materials are fabricated or work begun, submit complete coordination drawings prepared using 1/4” minimum scale with congested areas and sections through shafts at 3/8” minimum scale. Submit total sieving, piping, ductwork, electrical wiring and lighting, plumbing, fire sprinkler, baggage handling system, security/information technology/communications systems and HVAC coordination drawings.

4. The Contractor shall be solely responsible for coordination of the Work. Every civil, structural, baggage handling system, security/information technology/communications systems, mechanical and electrical Subcontractor shall be responsible for coordination of its portions of the Work with the Contractor and with each affected trade.

5. The Contractor shall schedule coordination meeting with Subcontractors to coordinate the Work for each work area. After coordination and corrections, each Subcontractor shall sign the originals of the coordination drawings. The Contractor shall submit coordination drawings to OAR for review indicating all conflicts that could not be resolved in coordination meeting. After review and
approval by OAR or Architect/Engineer, the Contractor shall prepare shop
drawings for each separate discipline, as required.

6. The Contractor shall coordinate with reflected ceiling plans exact location and
dimensioning of exposed items, and items which occur within hung ceilings. In
the event of a conflict, the Contractor shall request a clarification from the OAR
and Architect/Engineer as to the correct locations of items in question prior to
proceeding with fabrication or installation.

7. The Contractor shall prepare coordination drawings from drawings provided by
the Subcontractors as follows:
   a. Each Subcontractor shall prepare original drawings showing the
      respective work, layout, and type of the new and existing systems and
      lines along with supporting details of the new materials and systems
      including how the new work is integrated into the existing conditions. The
      submittal shall include any manufacturer’s specification sheets for any
      associated equipment. The Subcontractor shall certify the drawings with
      the Subcontractor’s signature prior to forwarding to the Contractor.
   b. The Subcontractor responsible for the civil work shall indicate on the
      drawings any utility relocations.
   c. The Subcontractor responsible for the fire alarm system shall indicate on
      the drawings the existing and new fire alarm components, fire alarm
      wiring to control panels.
   d. The Subcontractor responsible for the baggage handling system shall
      indicate on the drawings the existing and new system equipment and
      rights of way.

8. The Contractor shall resolve conflicts between the submittals of the
   Subcontractors prior to submission.

9. The coordination drawings are for the OAR, Construction Manager (CM), and
   Contractor’s use during construction and shall not be construed as replacing
   shop drawings or other Project Record Documents required by Contract
   Documents.

10. The review of coordination drawings by the OAR, CM, or Architect/Engineer
    shall not relieve the Contractor from the overall responsibility for coordination of
    the Work performed pursuant to the Contract.

11. Electronic media copies of CAD architectural or engineering data may be
    obtained from the Architect/Engineer upon approval of the OAR, for the
    express purpose of preparation of in-house coordination drawings or to use as
    the basis for preparing the Contractor and Subcontractor shop drawings by
    executing the required Release Form.

12. Provision of this CAD data is subject to both the terms described in this Section
    and on the Release Form.

13. The Contractor shall prepare composite shop drawings and installation layouts
    when necessary or requested to depict proposed solutions for field conditions.
    Coordinate in the field and with affected Subcontractors for proper relationship
    to the work of other Subcontractors based on field conditions.
1.7 SCHEDULE OF SUBMITTALS

A. The Contractor shall furnish the OAR with a schedule of submittals, within 30 Calendar Days of receipt of the Notice to Proceed (NTP). This schedule shall indicate, organized by Specification Section, the items to be submitted, the anticipated item submittal date, and the approximate number of shop drawing sheets (when applicable) to be included in the submittal.

B. Large and complex submittals may exceed the 14 Calendar Day review period as specified in the subsection 1.5. The OAR or Architect/Engineer shall identify these submittals (exceptions) upon receipt of the submittal schedule received from the Contractor.

PART 2 - PRODUCTS

2.1 GENERAL SUBMITTAL PROCEDURES

A. The Contractor shall provide submittals promptly in accordance with approved schedule of submittals and in such sequence as to cause no delay in the Work. Only the Contractor shall submit submittals to the OAR or Architect/Engineer unless specifically approved by the OAR. The Contractor shall provide submittals using the approved Skire Unifier software application unless otherwise noted or directed by the OAR.

B. The Contractor shall submit and upload shop drawings, and product data for structural, mechanical, fire protection and fire alarm systems, electrical, baggage handling systems, and security/information, technology/communications systems work using the Skire Unifier software application. The submittal shall be provided with a letter of transmittal contained within the approved Skire Unifier software application.

C. The Contractor shall submit product samples for structural, mechanical, fire protection and fire alarm systems, electrical, baggage handling systems, and security/information, technology/communications systems work in the original packaging to the OAR. The submittal shall be provided with a paper letter of transmittal along with the sample submission.

D. Any deviation from the Contract Documents shall be noted by the Contractor on the submittal with a detailed description of the deviation. Such a notation does not relieve the Contractor from complying with the requirements for a Substitution in accordance with Section 01 25 13.

E. The Contractor shall not be relieved of responsibility for deviations in submittals from requirements of Contract Documents by the review of the OAR or Architect/Engineer unless the response provides specific written acceptance of the specific deviation.

PART 3 - EXECUTION

3.1 CONTRACTOR REVIEW

A. The Contractor shall review each submittal prior to forwarding to the OAR. The Contractor shall determine and verify field measurements, field construction criteria, manufacturer’s catalog numbers, and conformance of submittal with requirements of the Contract Documents.

B. Coordinate the submittals with requirements of Work and of Contract Documents.
C. Apply the Contractor’s stamp, sign and stamp cover sheet of shop drawings, stamp cover sheet for product data, and each sample label to certify compliance with requirements of Contract Documents. All submittals shall be uploaded using the Skire Unifier software application, except as noted in subsection 2.1 C., and any deviations from requirements of Contract Documents shall be noted.

D. Submittals that include a product sample shall be provided to the OAR in accordance with subsection 2.1 C.

E. The fabrication of products or beginning work prior to the return of any approved submittal that impacts such work is performed at the sole risk of the Contractor.

F. Any submittal without the Contractor’s stamp and a submittal which is considered incomplete, contain numerous errors, or has not been checked or only checked superficially, will be returned without comments. Any resulting delays shall be the Contractor’s responsibility.

G. The Contractor shall be responsible for quantities and dimensions shown on the submittal taken from Contract Drawings.

3.2 RE-SUBMITTALS

A. The Contractor shall provide re-submittals under procedures specified for initial submittals and all changes since previous submittal shall be noted.

B. Shop Drawings and Product Data:
   1. Revise the original drawings or data, and resubmit as specified for initial submittal.
   2. Any revised drawing shall be noted with a revised or updated name or number in the title block.
   3. Indicate any changes which have been incorporated other than those requested by the previous review.
   3. Mark number of submission and resubmit to the OAR until the submittal is returned as “accepted”.

C. Samples: Submit new samples as required for initial submittal. Remove samples, which are not accepted or designated “RESUBMIT”.

PART 4 - MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART 1 - GENERAL

1.1 SUMMARY

This Section covers the requirements of the Contaminated Media Management Plan (CMMP) which provides the Airport Board, employees, tenants, and contractors with information and guidance on potential environmental concerns that may be encountered during the disturbance, excavation, and relocation of soils at the Airport.

1.2 SUBMITTALS

The Contractor shall submit to the Owner’s Authorized Representative (OAR) the following forms as noted in this Section:

A. Excavation Soil Management Form
B. Soil Transfer Request Form

1.3 REFERENCES

The following is a list of policies and regulations which may be referenced in this Section:

A. The Airport CMMP may be located at the following link:

1.4 QUALITY ASSURANCE

All personnel conducting environmental related construction activities shall possess the training and experience necessary to recognize environmental conditions, conduct soil screening, and use field instrumentation.

1.5 CONTAMINATED MEDIA MANAGEMENT PLAN

A. Refer to the complete CMMP located at
B. No soil can leave or be brought onto Airport property unless approved by the Airport Environmental Affairs Department (EAD).
C. Work Areas

1. The CMMP classifies a jobsite into three potential work areas: General Work Area, Area of Concern, and Remediation Area. Refer to the Plans for delineation of such work areas.

2. The work area delineation shown in the Plans is based on known potential contaminants. The work area delineation may change as new information becomes available during the course of the Project.

3. General Work Area

   a. The Contractor shall monitor all excavated soil and materials for visual and olfactory evidence of contamination and contact the OAR immediately if potential contamination is encountered. The OAR will contact the EAD for direction.
b. The Contractor shall complete the Excavation Soil Management Form to track excavation activities and the transport of soil and submit the form to the OAR and the assigned EAD representative weekly.

c. The Contractor shall monitor any water that collects on the Project site for visual or olfactory evidence of contamination. If no evidence of contamination is observed, the Contractor may pump the water in accordance with the applicable Stormwater Pollution Prevention Plans (SWPPP) or Erosion Control Plans (ECP). If contamination is present, the Contractor shall contact the OAR who will obtain the sampling requirements from the EAD.

d. The Contractor shall be responsible for all sampling and disposal of such materials.

4. Area of Concern

a. The Contractor shall sample the soil or field-screened every 50 cubic yards. The screening method is determined by the EAD based on the chemical of concern present onsite.

b. Photoionization Detector (PID)

1) The PID shall be equipped with a 10.6 eV lamp or greater and the equipment calibration shall be conducted on a daily basis regardless of manufacturer’s recommendations; and documented on the Excavation Soil Management Form.

2) If the Contractor encounters any PID readings greater than 25 ppm, the Contractor shall stop work immediately and contact the OAR who will contact the EAD for direction. Field screening shall be conducted every 50 cubic yards and all field screening results must be submitted to OAR who will forward to the EAD for review. The Contractor shall be responsible for all sampling and disposal.

c. Laboratory Analysis

The Contractor shall collect samples every 50 cubic yards and submit to a National Environmental Laboratory Accreditation Certification (NELAC) certified laboratory for analysis. All analytical reports shall be submitted to the OAR who will forward to the EAD for review. The Contractor is responsible for sample collection and analysis.

d. The Contractor shall complete the Excavation Soil Management Form to track excavation activities, field screening results, and the transport of soil. This form shall be submitted to the OAR and the assigned EAD representative weekly.

e. The Contractor shall monitor any water that collects on the Project site for visual or olfactory evidence of contamination. If no evidence of contamination is observed, the Contractor may pump the water in accordance with the SWPPP or ECP included in the Contract Documents. If contamination is present, the Contractor shall contact the OAR who will obtain the sampling requirements from the EAD.

f. The Contractor shall be responsible for all sampling and disposal of such materials.
5. Remediation Area
   a. The Contractor shall return the soil back into the excavation whenever possible.
   b. All soil generated that cannot be placed back in the excavation shall be stockpiled and sampled to determine appropriate soil classification.
      1) Excavated soils shall be stored on, and securely covered by, 10 mil. plastic sheeting or a similar method to protect the soil from exposure to rain or storm water runoff (i.e. lined roll-off). Any such soil shall not be combined or co-mingled with soils from other work areas within the Project.
      2) The Contractor shall collect a soil sample every 50 cubic yards and submitted to a NELAC certified laboratory for analysis. All analytical laboratory reports shall be submitted to the OAR and EAD for review. The Contractor shall be responsible for all sample collection and analysis. Refer to page 27 in the CMMP for additional details.
      3) The Contractor shall complete the Excavation Soil Management Form to track excavation activities and the transport of soil. This form shall be submitted to the OAR and the assigned EAD representative weekly.
      4) Water that accumulates on the Project site shall be sampled and the sample stored in a labeled, water-tight container. EAD will identify the chemicals of concern. Water samples will be collected and submitted to a NELAC certified laboratory for analysis. All analytical laboratory reports shall be submitted to the OAR and EAD for review. The Contractor shall be responsible for sample collection and analysis.

D. Soil Transfer
   1. The CMMP identifies the following methods to transfer soil:
      a. Deposit at an Airport stockpile area
         1) The Contractor shall complete the Environmental Authorization to Transfer Soil Form. The form shall be submitted to the OAR for EAD and the Design, Code, and Construction (DCC) Department review at least 48 hours in advance of scheduled deposition. The EAD and DCC must approve the request prior to any soil leaving the Project site.
         2) The soil must originate from either:
            a) A general work area with no visual or olfactory evidence of contamination; or
            b) An area of concern with either:
               i. PID readings of 0 ppm; or
               ii. Analytical samples with no detectible contaminants.
b. Remove from an Airport stockpile area
   1) The Contractor shall complete the Environmental Authorization to Transfer Soil Form. The form shall be submitted to the OAR for EAD and DCC review at least 48 hours in advance of scheduled removal. The EAD and DCC must approve the request prior to any soil leaving the Project site.
   2) The Contractor shall PID screen the soil every 50 cubic yards. PID readings must be below 25 ppm.

c. Transfer between Airport project sites
   1) The Contractor shall complete the Environmental Authorization to Transfer Soil Form. The form shall be submitted to the OAR for EAD and DCC review at least 48 hours in advance of scheduled removal. The EAD and DCC must approve the request prior to any soil leaving or entering the Project site.
   2) The soil must originate from either:
      a) A general work area with no visual or olfactory evidence of contamination; or
      b) An area of concern with either:
         i. PID readings below 25 ppm; or
         ii. Analytical samples with no detectible contaminants; or
         iii. Analytical samples below the Texas Risk Reduction Program (TRRP) residential standards and placed in a “capped” location

d. Import material from off the Airport
   The Contractor shall complete the Environmental Authorization to Transfer Soil Form. The form shall be submitted to the OAR for EAD review at least 48 hours in advance of scheduled delivery. The EAD must approve the request prior to any soil entering the Project site.

e. Export material off the Airport
   1) The Contractor shall complete the Environmental Authorization to Transfer Soil Form. The form shall be submitted to the OAR for EAD review at least 48 hours in advance of scheduled removal. The EAD must approve the request prior to any soil leaving the Project site.
   2) The soil must originate from either:
      a) A general work area with no visual or olfactory evidence of contamination; or
      b) An area of concern with either:
         i. PID readings below 25 ppm; or
         ii. Analytical samples with no detectible contaminants; or
iii. Analytical samples below TRRP residential standards and placed in a “capped” location.

PART 2 – PRODUCTS
Not Used.

PART 3 – EXECUTION
Not Used.

PART 4 – MEASUREMENT AND PAYMENT
Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 AOA PROCEDURES

A. These Procedures specify requirements and limitations imposed on construction and maintenance activity within the Aircraft Operations Area (AOA), the purpose of which is to ensure the safe and efficient operation of the Airport while providing maximum allowable flexibility for personnel. Any deviation from the procedures as stated herein constitutes a violation and shall be subject to enforcement in accordance with subsection 1.14.

B. Construction projects at the Airport are reviewed through conferences prior to the start of work to establish the parameters within which the work can be performed.

C. Construction projects within the Security Identification Display Area (SIDA)/AOA require that personnel display appropriate Airport Access/Identification Badges issued in accordance with subsection 1.11.

D. Motor vehicles entering the AOA must display an AOA Access Permit and be in compliance with subsection 1.12.

E. Construction projects that take place in the public areas of terminal concourses (sterile area) to include “back of house” areas such as offices and concessions within the Security Identification Display Area/Air Operations Area (SIDA/AOA) require a tool management plan in accordance with Section 01 35 13.01.

F. Prior to beginning the Project, the Contractor shall submit to the Owner’s Authorized Representative and the Airport Department of Public Safety (DPS) a security plan that describes how the Contractor intends to provide for the security of the construction site, Contractor staging area, and property throughout the duration of the project.

G. The Contractor’s Authorized Representative (CAR) is responsible for ensuring that these procedures are followed. Any exceptions require specific authorization by the Airport’s Operations Department and DPS on a case-by-case basis.

H. Disruption of underground Utilities on the Airport can cause degradation of aviation safety, and wide spread loss of the use of airport facilities and or services. Procedures concerning underground utilities location and protection are located in Section 01 18 16, and shall be adhered to at all times.

I. Progress meetings are to be held weekly unless otherwise stated in Contract Documents, in order to discuss schedules, planned closures, dig book, safety and security issues, and other related matters.

J. The Contractor is required to conduct daily safety briefings with all workers who will access AOA construction sites and include topics relevant to these requirements and the activities being performed. Discuss specific project movement restrictions as well as general AOA safety procedures and guidelines. Follow the safety meeting agenda provided by the Owner’s Authorized Representative (OAR). The meeting will be conducted both in English and Spanish when the size of the worker population requires bilingual communications, and will be attended by all Contractor and subcontractor personnel working inside the AOA that day. The Contractor shall record meeting attendance, including attendees’ names and employers, and shall provide a copy of the attendance sheet to the OAR. Failure by the Contractor or Subcontractor personnel to attend these mandatory meetings could result in AOA access being denied to those individuals.
K. The Contractor’s designated Quality Control representative will conduct an “AOA Readiness Checklist” review with all personnel prior to crews entering the AOA. The AOA Readiness Checklist form is included in Section 01 35 13.13.01.

1. The AOA Readiness Checklist is to be provided by the OAR upon completion. The purpose of the checklist is to ensure that all personnel entering the AOA understand the limits of the designated work area, have all tools, materials, and equipment necessary to complete the planned activities, and have verified the operability of all powered equipment and hand tools prior to entering the AOA.

2. The intent of the AOA Readiness Checklist is to reduce or eliminate superfluous travel to and from the work site due to Contractor’s lack of initial readiness. The OAR will not call for Operations escort until the checklist review is complete.

L. Prior to the start of any project on the AOA, the Contractor, through the OAR, shall provide the Airport Operations Center (AOC) with an Emergency Phone List listing the pager, cell phone and/or home phone numbers of key members of the construction team including the OAR. The listing shall be in priority order for contacting personnel during off-duty hours, and specifically identify the individual(s) on call 24-hours a day for emergency maintenance of hazard lighting and barricades. This list shall be revised as required.

M. Project management including the Contractor’s Safety Officer must be on duty at the Airport whenever the Contractor is performing work on the AOA.

N. The Contractor shall document the condition of the work site and access roads to it prior to start of construction and restore the area to original (or better) condition when area is no longer marked as a construction site. This requirement does not apply to attaining a stand of grass as long as grass has been planted.

1.2 FORMS AND INSTRUCTIONS

A. The following forms and instructions are included in Section 01 35 13.13.01 for the Contractor’s use, as applicable on the Project:

1. Contractor’s AOA Readiness Checklist
2. Lockout Procedure for Airfield Series Lighting Circuits
3. Lockout Log for Airfield Series Lighting Circuits
4. Airfield Closure/Activity/Circuit Lockout Request Form
5. Airfield Closure/Activity/Circuit Lockout Instructions
6. Airport Construction Security Procedures Tool Management Plan
7. AOA Escort Release/Pick up Point Notice/Instructions
8. Airport Airspace Review Form

1.3 CONSTRUCTION - AIRCRAFT MOVEMENT AREA

A. When construction is being performed within the Aircraft Movement Area (AMA), the following procedures will apply:

1. All vehicle operators shall abide by the Airport Driving Handbook, published by the Operations Department and available at the following location:

2. The OAR will provide notification to and obtain approval from Airfield Operations before entering the AOA and proceeding into the construction site.

3. Approval to enter closed areas within the Movement Area must be obtained from Airfield Operations Port Control.

4. A log of each vehicle entering and exiting the closed area shall be maintained by Port Control or his/her designee.

5. Contractors are required to obtain approval to clear a work site which must be compliant with these requirements.

6. The OAR will again notify Airfield Operations when the construction activity has been cleared of all personnel.

7. Summary of Notification Requirement: Notify the OAR in advance of commencement of the following work activities by not less than the number of calendar days shown:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Notice (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Work Activities in AOA</td>
<td>Daily **</td>
</tr>
<tr>
<td>2. Airfield Operations Escort</td>
<td>2</td>
</tr>
<tr>
<td>3. Installation of Safety Area and Object Free Area boundary and Haul Route Markers</td>
<td>5</td>
</tr>
<tr>
<td>4. Temporary Lighting</td>
<td>5</td>
</tr>
<tr>
<td>5. Disconnect or Disabling of Power Circuits</td>
<td>5</td>
</tr>
<tr>
<td>6. Rerouting of ARFF Road</td>
<td>14</td>
</tr>
<tr>
<td>7. Runway/Taxiway Closure (First Notice)</td>
<td>30*</td>
</tr>
<tr>
<td>8. Runway/Taxiway Closure (Second Notice)</td>
<td>7</td>
</tr>
<tr>
<td>9. Crane Operations (FAA Approval)</td>
<td>60*</td>
</tr>
</tbody>
</table>

*Denotes "Notice" process initiated by the Airport  
** Daily schedules of work activities, closures, and circuit lockouts within the AOA must be submitted in writing by email or other means to the Coordination Center.

B. Vehicle Operator

1. As approved by Airfield Operations, contractors may designate personnel to complete Airport-approved training for driving within the AMA. Successful completion of the annual training includes passing all required tests.

2. Trained and qualified vehicle operators shall only drive routes within the AMA specified by Airfield Operations. These routes shall not include crossing of an active Runway or any portion of an active Runway Safety Area (RSA). Vehicle operators will not operate in the AMA during Surface Movement Guidance & Control System (SMGCS) Conditions (low visibility operations).

3. No vehicle shall operate unescorted within the AMA unless it is equipped with an operational flashing yellow beacon, an Airport Board radio (800 MHz, contractor furnished), and a VHF frequency radio (contractor furnished) to monitor FAA ATCT communications. This does not apply to crossing a Taxiway.
through an approved flagging operation.

4. All vehicles, unescorted and escorted, operating within the AMA shall not interfere with aircraft operations and must always yield right-of-way to aircraft and emergency vehicles.

5. Airfield Operations may suspend or discontinue contractor vehicle operations involving AMA-trained drivers at any time it is deemed necessary for safety and/or operational purposes.

C. Personnel Escort Requirements

1. At least one person with escort privileges possessing an Airport Identification/Access Badge must escort any individual or group of un-badged persons.

2. The proximity of the badged person to non-badged person(s) must be such that the unbadged person(s) must remain within sight and sound of the escort at all times and be under the control of the badged escort individual at all times.

3. At a minimum, the CAR, Contractor’s Quality Control Representative, Safety Officer, and all Subcontractor superintendents, foremen, and lead men will be badged. Although other members of the construction work force may obtain an Airport Identification/Access Badge, not all badged personnel will be granted escort privileges based on job classification.

4. The maximum ratio for escorting individuals within the AOA/SIDA will be one AOA badged individual to five non-badge individuals.

D. Vehicle Escort Requirements

1. Each Certified Movement Area Escort (CMAE) must be currently licensed as required by the State of Texas, possess valid insurance coverage as required by the Airport, possess a valid Airport Identification/Access Badge, and be thoroughly familiar with the provisions of this Section. A CMAE must escort all other vehicle operators at all times within the movement area.

2. A CMAE must possess their unexpired AMA Driver’s Certification on their person during all times driving unescorted within the AMA. That certification must be presented to an Airport Board employee upon request.

3. In order to sustain AMA driving privileges, a CMAE must ensure training (retraining) is completed within 12 calendar months of their initial or previous retraining session.

4. The vehicle operated by a CMAE during the performance of a vehicle escort within the AMA shall be clearly marked with "ESCORT" on both sides and on the back of the vehicle. The minimum height of the letters must be four (4) inches. Magnetic signs are acceptable.

5. A maximum of five (5) vehicles may be escorted for a total of six (6) vehicles including the escort.

6. Vehicle operators must have the ability to communication via radio or phone with project management and each vehicle must possess a map of the Project site with detailed depictions of AOA entrance/exit points, Haul Roads, restricted areas, and other vital information.

7. Dedicated escort requirements must be coordinated with Airfield Operations in
advance through the OAR.

E. All vehicle escorts must enter the AOA through a DPS Security services staffed AOA gate.

F. The escort and person(s) to be escorted will meet prior to the escort and verbally communicate the location of the intended destination, the route to be taken, and give further instruction as necessary. All escorts for construction projects on the AOA, including, without limitation, the AMA, shall be performed in a manner calculated to ensure that the escorted party (Contractor equipment, vehicles, personnel, etc.) will be released from the escort only at the designated Release Point inside the construction work area.

Details of Contractor Provided Escort Operations (Details of an Airport provided escort are identical to using an Airfield Agent):

1. The CMAE will arrive at location to begin an escort.

2. The CMAE will get out of his/her vehicle and meet with all personnel who will be under their escort and will pass out laminated Release/Pick-Up Point Escort Instruction sheets to the operator of each vehicle to be escorted.

3. The CMAE will ensure there is at least one (1) badged person for every five (5) non-badged persons.

4. The CMAE shall verbally instruct each vehicle operator to follow the escort vehicle at all times, and as closely as considerations of safety will permit, until the vehicles are released from the escort at the Release/Pickup Point preferably located at least 50’ inside of the construction work area. Contractor shall be responsible for the materials and maintenance of the Release/Pickup Point.

5. The CMAE will then escort the vehicles to the Release Point within the construction work area.

6. Upon arrival at the construction work area Release Point, the CMAE will drive around it and verify that all vehicles have arrived.

7. After the CMAE has verified that all escorted vehicles have arrived, all escorted vehicles will be directed to stop and their drivers to return the laminated escort instruction sheets back to the Airfield Operations employee.

8. Same procedure will apply for escorting vehicles out of the construction work area to an AOA gate.

9. The CMAE will not terminate the escort or release any escorted party except at a designated Release Point. For example, the CMAE shall not release the vehicle(s) being escorted outside of a cone line established for a closure and allow the vehicles to drive past the cone line into the work area unescorted. The CMAE will perform the escort past the cone line into the construction work area.

10. The CMAE will release the escort at the designated Release Point, ensuring all vehicles being escorted follow the escort vehicle past the established cone line and inside to their work area.

11. An Escort performed to construction work areas on the AOA in which a closure of a Taxiway or Runway is not in effect and an established Release Point is not
being used will be conducted in a manner that the vehicles will be released at
the designated point agreed to by the CMAE and the person being escorted.
The release of the escort will be agreed to at the verbal briefing performed prior
to the CMAE getting underway.

G. Airport provided escorts must be coordinated with Airfield Operations in advance
though the OAR.

H. Contractors may perform an escort only along established Haul Roads provided the
following procedures are adhered to:

1. The vehicle operator displays a valid Airport Identification/Access Badge.
2. The vehicle displays a valid AOA Access Permit.
3. The vehicle is clearly marked with a three-foot square orange and white
checkered flag for daytime activities or a 360-degree rotating or flashing
amber light for daytime or nighttime activities.
4. Supervisor vehicles shall have a rotating or flashing amber light that operates
continuously

NOTE: Only authorized Airport Board and FAA personnel or their assigned
agents may perform escorts off established Haul Roads.

1.4 Haul Roads

A. Airfield Operations must approve the establishment of Contractor Haul Roads. Prior
to approving Haul Road activities, the following must be established:

1. Green flags or markers, not to be smaller than six (6) inches square mounted
on wooden stakes no higher than 18 inches above the ground, must
prominently mark each side of the Haul Road at intervals of not more than 100
feet apart.

2. Stop signs (30 inches x 30 inches), or other traffic control devices, conforming
to the Texas Manual of Uniform Traffic Control Devices (TMUTCD), must be
clearly posted on either side of intersecting roadways, emergency roads,
Taxiways and other areas specified by the Airfield Operations. Signs must
normally be no nearer than 160 feet (193 feet for certain taxi routes) from the
Taxiway centerline or 10 feet from the edge of the emergency road.

3. In some cases, traffic control signal lights may be required for controlling
Taxiway crossings. When signal lights are used, they shall have either 8 inch or
12 inch circular red and green lenses, and shall normally be located a minimum
of 160 feet (or up to 193 feet) from the Taxiway centerlines and between 2 and
10 feet from the outside edge of the Haul Road surface. The signal height shall
be no less than 9 feet or more than 15 feet above the Haul Road surface.
Approval for use of traffic control signal lights will be approved on a case by
case basis only by Airfield Operations.

4. Flaggers, wearing bright reflective outer clothing, shall be posted at each
crossing to control Haul Road traffic either through flags or traffic signals. A
flagger may not be allowed to perform any other function and must be able to
speak and understand English.

For active Taxiway crossings, flaggers shall have completed Airport-approved
training concerning the AMA. Successful completion of the annual training
includes passing all required tests. Each flagger must actively monitor a VHF tower radio (Contractor furnished) tuned into the appropriate frequency when engaged in flagging operations at or near an active Taxiway. Unless otherwise specified, a flagger is required on each side of the active Taxiway to be crossed, i.e., two (2) for a single crossing point.

5. Paved areas must be kept clean at all times. An operational sweeper driven by a CMAE shall be provided at each active Taxiway crossing during hauling operations.

6. All vehicles shall stop at each Taxiway and/or emergency road before crossing to ensure the route is clear.

7. Construction vehicles must yield right-of-way to all Airport vehicles and aircraft at all times.

8. Hauling operations will be discontinued at the direction of Airfield Operations when the operation of the airfield warrants due to inclement weather or other conditions affecting aircraft movement.

9. Provide wheel wash stations for the removal of mud from trucks and other vehicles at the following locations:
   a. Prior to entry onto public thoroughfares.
   b. Prior to crossing Airport roadways, Ramps, Taxiways and Runways.

   **Note:** If the Contractor can successfully exhibit his ability to keep the paved areas, listed above, clean, the OAR may waive the requirement for wheel wash stations.

### 1.5 CLOSING AIRFIELD AREAS

A. No portion of the airfield may be closed to aircraft or vehicles without specific authorization from Airfield Operations. Any construction activity that affects the utilization of roadways, Taxiways, Runways, Navigational Aids (NAVAIDs), or associated electrical circuits must be prearranged and scheduled in accordance with contract documents, and specific approval granted by Airfield Operations. The Lockout Procedure for Airfield Series Lighting Circuits is included in Section 01 35 13.01.

B. The following activities are considered an impact to airfield areas and require closures:

1. Obstruction of any roadway or emergency access road.

2. Objects, excavations, men, or material within:
   a. Runway Safety Area - 250 feet from the centerline
   b. Runway Safety Area - 1000 feet off the end
   c. Taxiway Object Free Area - 160 feet from centerline (193 feet for certain taxi routes)
   d. Taxilane Object Free Area - 138 feet from centerline (up to 167 feet for certain taxi routes)
   e. Within a NAVAID Critical Area (NCA)
C. Initial notification of intended airfield closures should be prearranged no less than 30 Calendar Days in advance, except where noted otherwise within the Contract Documents or as granted by Airfield Operations on a case-by-case basis.

D. In order to enable proper coordination of airfield activities, a description of all AOA activity and planned closures must be e-mailed to the Coordination Center by 11:00 a.m. of the morning preceding nighttime closures (7:00 p.m. to 7:00 a.m.) and/or the following day’s daytime closures (7:00 a.m. to 7:00 p.m.). For closures on a holiday, daytime on the day following a holiday, Saturday, Sunday and daytime on Monday, the request must arrive at the Coordination Center by 11:00 a.m. on the last Working Day prior to the holiday or weekend. The Contractor will complete an Airfield Closure/Activity/Circuit Lockout Request form, included in Section 01 35 13.13.01, and submit to the OAR with time to meet the requirement to receive the request to the Coordination Center by 11:00 a.m. Notification of cancellation of scheduled closures should be submitted to the Coordination Center by the most expeditious means available.

E. Airfield Operations reserves the right to refuse any closure due to unforeseen conditions that may require continued utilization of the area for aircraft operations. These conditions include, but may not be limited to:
   1. Inclement weather/low visibility conditions
   2. Delayed aircraft operations
   3. Closures of higher priority (e.g. urgent maintenance activities)
   4. Emergency situations

F. Closures require the placement of low profile barricades (edge of grass to edge of grass) with reflective tape and red flashing lights placed across closed Taxiways or portions of the Runway. Airfield Operations can require the Contractor to modify the locations of the barricades from what may be shown on the Plans if in their opinion such modification is necessary due to aircraft utilization of the Airport. Lighted cones may be approved in certain circumstances at the discretion of Airfield Operations. For closures involving a cross Taxiway intersecting at a Runway, the closure will include the portion of that same Taxiway on the opposite side of the Runway.

G. Runway closures require the placement of lighted “X's” at each end of the Runway if personnel or equipment will be on the Runway at any time. Preferably, those will be trailered X’s. Note, Runway closures are only restrictions for aircraft takeoffs and landings and not necessarily restrictions for aircraft taxi operations on available Runway pavement.

On Runways with intersection departures, the placement of barricades (edge of grass to edge of grass) with reflective tape and red flashing lights placed across the closed Runway to prevent inadvertent departures from the intersection will be directed by Airfield Operations.

H. For work that requires any Runway closure, any required construction equipment, materials, etc. shall be mustered on-site or at a designated area approved by the OAR prior to the execution of a Runway closure. Prior to a Runway closure, the Contractor may also be required to demonstrate the good working order of his equipment, availability of materials if off-site, adequacy of material quantities on-hand, or any other factors which might delay the Contractor’s work and subsequent
reopening of the closed Runway to the satisfaction of the OAR and/or Airfield Operations.

I. All areas closed to aircraft operations must be prominently marked and lighted in accordance with these standards, or as directed by Airfield Operations or the OAR. **No construction activities will be allowed to begin prior to completion of all marking and lighting requirements as well as the installation of the Release/Pick up Point.**

J. Taxiway guidance signs, centerline lights, and edge lights that could otherwise lead an aircraft into a closed area shall be deactivated and/or covered as directed by Airfield Operations. Signs must be obscured with blank panels. Plastic wrap is prohibited.

K. Taxiway centerline markings that could otherwise lead an aircraft into a closed area shall be obliterated by means of water blasting. Any existing markings that are effected by the removal operations must be restored for continuity, i.e., centerline removed over top of Runway edge marking.

L. For any work activity located at or beyond the Runway holding position markings and on or within 50 feet of pavement, a Runway closure is required regardless of the distance from the Runway centerline.

1.6 MARKING AND LIGHTING

A. All construction equipment must be marked by a 3-foot square orange and white checkered flag during daylight hours or an amber rotating or flashing beacon during daylight or nighttime. Supervisory and escort vehicles must display a 360-degree amber rotating or flashing beacon. For nighttime construction, certain other vehicles, cranes, and pieces of construction equipment may require lighting as directed by Airfield Operations.

B. All excavations and closed areas on the AOA must be prominently marked with low profile barricades with reflective tape and lighted with red flashing lights or as directed by Airfield Operations and the OAR.

C. The low profile barricades shall be interconnected and must extend from edge of grass to edge of grass or across entire paved surface of closed area.

D. No construction activities will be allowed to end before all excavations have been marked and lighted as required.

E. Excavations adjacent to full strength Taxiway pavement of an active Taxiway or excavations within a Taxiway Safety Area shall be marked with lighted barricades that must be as low as possible to the ground; of low mass; easily collapsible upon contact with an aircraft or any of its components; and weighted or sturdily attached to the surface to prevent displacement from prop wash, jet blast, wing vortex, or other surface wind currents. If the barricades are affixed to the surface, they must be frangible at grade level or as low as possible, but not to exceed 3 inches above the ground. Non- frangible hazard markings, such as concrete barriers, metal-drum type barricades or timbers (railroad ties) shall not be used in the AOA.

F. Excavations within the Non-Movement Areas shall be marked with collapsible barricades marked with diagonal, alternating orange and white stripes; each barricade attached or joined together with two flashing red lights on each end.
G. Excavations within 10 feet of emergency roads shall be marked with lighted Type A barricades or Airport approved traffic control devices.

H. Orange construction fencing shall be used in the AOA as depicted in the construction phasing plans in accordance with the following:
   1. Plastic construction fencing shall not be utilized within a Runway or Taxiway Object Free Area (OFA), within 138 feet (up to 193 feet in some locations) of a taxilane centerline, or in any other area where jet blast could be a problem.
   2. Approval of the material by the OAR is required before using construction fencing on the AOA.
   3. Construction fencing and supports must be kept in a satisfactory condition (all supports in place, material securely attached to the supports and no tears in the material).
   4. The use of construction fencing is no substitute for prominently marking and lighting an excavation.
   5. When used to mark the boundaries of the construction site, the posts shall have a white reflective marker at the top of the post that is visible from outside the construction site.

I. Barricades, cones, and/or construction fence shall be removed when directed by the OAR or when the requirement for marking of hazardous areas no longer exists.

J. Release/Pick Up Point markings shall consist of 3 foot square black and white checkered flag located within a group of five (5) orange cones with amber lights placed 50 feet inside of the closed area.

K. All marking, lighting, signs, flags, cones, barricades, and other safety related devices shall be maintained to 100 percent serviceability at all times.

1.7 SAFETY AREAS

A. A Safety Area is the surfaces surrounding a Runway and Taxiway in which no potentially hazardous ruts, humps, depressions, or other surface variations (in excess of 3 inches) may exist. Surface conditions must be capable under dry conditions of supporting the Aircraft Rescue and Fire Fighting (ARFF) vehicles and other heavy equipment, and supporting the occasional passage of aircraft without causing major damage to the aircraft.

B. Safety Area dimensions are as follows:
   1. Runways: 250 feet either side of centerline, 1000 feet off each end.
   2. Taxiways: 107 feet either side of the centerline, total 214 feet side (131 feet from centerline on certain taxi routes).

C. The Contractor may be required to immediately terminate his work within an RSA at the instructions of the OAR or Airfield Operations. Work may be performed outside an RSA without closure as long as weather minimums are not less than 1000-foot ceiling and/or 3 miles visibility.

D. Barricades with lights will be required to mark the RSA adjacent to the actual work areas.

E. Barricades will be required to be placed on both sides of the nearest Taxiway intersection to prevent any planes turning into the closed area.
1.8 OBSTACLE FREE ZONE

A. An Obstacle Free Zone OFZ is a three-dimensional area involving imaginary surfaces in the vicinity of a Runway. Objects, vehicles, and stockpiled material will not be permitted to penetrate an OFZ whenever the weather conditions are below an 800 foot ceiling or less than two miles visibility and aircraft are using an Instrument Landing System (ILS) approach.

B. OFZ surfaces are as follows:

1. An inner-transitional surface OFZ begins at 200 feet from the Runway centerline, rises vertically to an elevation of 39 feet above the Runway elevation, and then slopes 6:1 to a height of 150 feet above the established Airport elevation. (For Category II/III Runways, the surface rises vertically to an elevation of 23 feet above the Runway elevation and then slopes 5:1 for a distance of 657 feet from the Runway centerline, then slopes 6:1 to 150 feet above the established Airport elevation.)

2. An inner-approach OFZ begins 200 feet from the Runway threshold at the same elevation as the Runway threshold and ends 200 feet beyond the last approach light unit. Its width is 400 feet and it rises at a slope of 50:1.

3. Objects that do not penetrate the OFZ may still require approval by the Airport Operations Department based on the requirements contained in Federal Aviation Regulation Part 77.

C. Object Free Area

1. An Object Free Area (OFA) is a two-dimensional area surrounding a Taxiway and Taxilane within which no object may be located that is not completely mobile and capable of clearing the OFA for each passing aircraft. EXCEPTION: Airport Approved objects such as barricades, markers, flags, and lights used to define excavations are allowed to remain within the OFA.

2. Normal OFA dimensions are as follows:

   a. Taxiways - 160 feet from centerline. (193 feet for certain taxi routes).

   b. Taxilanes - 138 feet from centerline. (167 feet for certain taxi routes).

3. Airfield Operations must authorize construction activities within OFAs in advance.

4. No objects will be allowed to remain within a Taxiway or Taxilane OFA above barricade height.

5. At the approval of Airfield Operations, mobile equipment and/or personnel on foot may operate within the OFA provided it is properly marked and lighted, and a flag person is used to signal the pullback of all persons and equipment for each passing aircraft. A flag person may not be allowed to perform any other function.

6. Using "pull back" procedures when working within a Taxiways' OFA during nighttime hours is prohibited unless the area of work has sufficient light in the opinion of Airfield Operations. Sufficient light may include artificial light that is either existing or supplied by the Contractor. If it is chosen to bring in additional artificial light for the work area, a layout plan shall be submitted to Airfield Operations for approval. At a minimum, the plan shall show the type(s) of light,
the location of light(s) and whether or not the light(s) will be shielded. Airfield Operations may require additional information to determine the impact of construction lights on airfield operations.

Exception: No activities will be allowed within 160 feet (193 feet for certain taxi routes) of a High Speed Exit (HSE) Taxiway unless that HSE Taxiway is closed.

D. NAVAID Critical Area
1. Work will not be authorized within an NAVAID Critical Area (NCA) without specific approval by Airfield Operations.
2. NCAs include Runway ILS NAVAIDS and microwave signal paths.

E. Criteria for Marking Construction Sites, Safety Areas, OFA, and NCAs
1. White markers or flags are used to prominently mark the boundaries of construction sites when such marking is determined to be feasible. Alternatively, orange construction fence may be used for this purpose in accordance with subsection 1.6.H above.
2. Red markers or flags must prominently mark the boundary of a RSA and a Taxiway OFA. Prior to beginning any activity within 50 feet of the RSA or Taxiway OFA, the boundary shall be further marked with low profile barricades that are interconnected.
3. Yellow markers or flags must prominently mark the boundary of a Runway OFA (400 feet from a Runway centerline) and an NCA. NOTE: Construction activities are subject to being terminated whenever visibility is at or below 3/4 mile, except as approved on a case-by-case basis.
4. All markers/flags must be made of reflective material and be no smaller than 6 inches square mounted on 2 inches x 2 inches wooden stakes no higher than 18 inches above the ground. Each marker or flag must be placed no further apart than 50 feet and extend to the limits of the construction site. NOTE: Airfield Operations on a case-by-case basis may grant exceptions.
5. No work shall begin in areas requiring these markers or flags until the OAR have confirmed the correct placement.
6. The markers or flags must be continuously maintained as installed unless work is confined to periods when the associated Runway, Taxiway, or Taxilane is closed or the NAVAID has been removed from service.
7. Workers and equipment are prohibited from passing beyond red or yellow markers or flags designating a Safety Area, OFA, or NCA without the approval of the OAR as obtained from Airfield Operations on a case-by-case basis except when the associated Runway or Taxiway/Taxilane is closed.
8. Markers or flags shall be removed when directed by the OAR or when work within these areas is completed.

F. Trenches, Excavations, and Stockpiles
1. No trenches or excavations will be permitted within the following areas:
   a. Within 250 feet of a Runway centerline (200 feet if approved by Airfield Operations).
b. Within 1000 feet from the Runway end.

c. Within 107 feet (131 feet on certain taxi routes) of a Taxiway centerline unless the opening is properly barricaded and lighted.

2. Stockpiles (including spoils piles) are not permitted within the boundaries of the AOA; however, the Contractor may submit a request to the OAR for a stockpile within the AOA. When such a stockpile is permitted, it shall be restricted to 3 feet tall and shall not be permitted in the following areas unless additional specific approval has been granted:
   a. Within 400 feet of a Runway centerline.
   b. Within 160 feet of a Taxiway centerline (193 feet on certain taxi routes).
   c. Within 138 feet of a Taxilane centerline (167 feet on certain taxi routes).
   d. Within 2700 feet of the end of a Runway (Runway OFA Extension).
   e. Within an NCA.

3. All trenches, excavations, and stockpiles must be prominently marked and lighted.

G. Staging of Construction Equipment

1. Construction equipment is not permitted to be staged (stored) within the boundaries of the AOA; however, the Contractor may submit a request to the OAR for equipment storage within the AOA. When such an authorization has been obtained, the equipment shall not be permitted in the following areas unless additional specific approval has been granted:
   a. Within 400 feet of a Runway centerline.
   b. Within 160 feet of a Taxiway centerline (193 feet on certain taxi routes).
   c. Within 138 feet of a Taxilane centerline (167 feet on certain taxi routes).
   d. Within 2700 feet of the end of a Runway (Runway OFA Extension).
   e. Within an NCA.

2. All construction equipment authorized to be staged (stored) within the boundaries of the AOA, must be prominently marked and lighted as directed and approved by the OAR.

H. Use of Extended Height Equipment

1. The use or installation of extended height construction equipment (more than 20 ft. high) such as cranes, "cherry pickers", drill rigs, and batch plants are prohibited without prior approval of the Airport.

2. The Contractor shall provide advanced notice for the use of such equipment at any location on the Project site. The Contractor shall complete and submit to the OAR the Airport Airspace Review Form included in Section 01 35 13.13.01.

3. No such equipment shall be transported onto the Airport site prior to the approval of Airfield Operations through the OAR.

4. If utilized at night or in conditions of poor visibility (less than 3 miles visibility), the equipment must be lighted in accordance with FAA Advisory Circular 70/7460-1 (most current version) Obstruction Marking and Lighting and/or as
directed in the airspace study. Lights must be visible throughout 360°, and steady burning red lights must have a minimum light intensity of 32.5 candelas and flashing red lights shall have a peak effective intensity of 2000 ± 25% candela.

5. This equipment shall be lowered to its stowed height when not in use or as directed by the OAR in concurrence with Airfield Operations.

I. Maintenance of Construction Areas

1. Construction boundaries shall be clearly defined and marked/fenced as directed by Airfield Operations.

2. The Contractor shall be responsible for maintaining construction areas to the same standards used on the remainder of the airfield including such items as:
   a. Maintaining grass height of 6 inches to 10 inches.
   b. Maintaining the work area to remain clear of debris, trash, and excessive construction materials at all times.
   c. Maintaining all markers, barricades, cones, signs, lighting and erosion control devices in proper working/functional condition.

1.9 CONSTRUCTION - NON-MOVEMENT AREAS

When construction activity is performed within the Non-Movement Area of the AOA (Ramp, Taxilane, etc.), the procedures established for the movement area generally apply unless otherwise authorized by Airfield Operations, EXCEPT:

Unescorted access though Terminal Security Gates is limited to those persons displaying a valid Airport Identification/Access Badge encoded with "terminal gate access" authorization. The term "Terminal gate access" is defined as any badge holder whose badge has been encoded to grant access through security gate checkpoints within passenger terminals. Those badge holders who do not have terminal gate access privileges encoded in their badge must be escorted by someone who has terminal access privileges.

1.10 AIR OPERATIONS AREA SECURITY

A. Each employee working within the AOA must be briefed on AOA security regulations and a record of such training maintained by the Contractor. Each employee must attend AOA Safety Coordination meetings prior to the start of work within the AOA that includes security enforcement subject matter. Failure to attend may result in employee being denied access to the AOA.

B. Each non-badged employee that is allowed escorted access to the AOA for the purpose of construction activities must possess and render for inspection government-issued picture identification. Identification documents shall be subject to being verified through a credential check process by the Airport. All non-badged individuals will be required to carry valid government issued identification with them at all times while working inside the AOA.

C. It is the responsibility of every Airport Identification/Access Badge holder to challenge anyone in the AOA who does not have an Airport Identification/Access Badge prominently displayed unless that individual is under escort by a properly badged individual with escort authority.
D. Construction storage/office areas located outside the AOA must be secured to prevent unauthorized entry by the public.

E. The Contractor shall maintain project related AOA fences intact and secure at all times. A 10 foot clear zone will be maintained on both sides of the fence. The clear zone will remain free of stockpiled materials and/or vehicles.

F. Notify Airfield Operations each Working Day, through the OAR, prior to initial entry of any personnel into the AOA. Airfield Operations shall be notified again after the last personnel leave the AOA at the end of each workday.

G. The Contractor shall utilize approved AOA staffed gates to gain access to the AOA provided coordination has been made through the OAR and the DPS. The Contractor may also request approval from the Airport Operations Department and the DPS to install a new gate (normally such gates are not approved within the SIDA). If approved, a gate number will be assigned by DPS and a work order will be submitted to install a DPS approved lock. Gates in the Central Terminal Area (CTA) will require Access Control equipment and will be manned by DPS Security Officers. Gates not located in the CTA will also be manned by DPS Security Officers.

H. The Contractor will be responsible for funding and coordination of staffing with DPS and the OAR. Additionally, the Contractor will be responsible for installing an air conditioned and heated security post, restroom and telephone. Specifications for guard houses may be obtained from the Airport Design Criteria Manual. Any exceptions will be at the discretion of the DPS.

I. All AOA gates, that are not automatic or manned, shall be secured with a single Airport locking mechanism.

J. The use of Contractor provided locks in place of or in addition to Airport locks is specifically prohibited. The DPS will not issue an AOA gate key to the Contractor or any Subcontractor on the Project.

K. In the event that construction requires a portion of the AOA fence or gate to remain open on a temporary basis, the opening will be secured by a DPS Police or Security Officer.

1. The Contractor shall be responsible for the funding and coordination of staffing with DPS. The DPS provides Police or Security Officers from the off-duty employment pool. Contact the DPS Airport Security Staffing Coordinator (972-973-4710) or by email at asi@dfwairport.com.

2. All fence openings or gates shall remain closed until the Security Officer has verified the vehicle and all occupants are authorized to enter the AOA.

3. Persons or vehicles with proper identification shall be denied entry if their presence in the AOA is not related to the Project. Unauthorized entry shall be reported immediately to the DPS and the AOC.

L. Entrance through Terminal Security Gates in the CTA may be permitted under the following conditions:

1. Unescorted access though Terminal Security Gates is limited to those persons displaying a valid Airport Identification/Access Badge programmed with "access" authorization in a vehicle displaying a valid AOA Vehicle Access Permit.

2. A person issued an Airport Identification/Access Badge with "access" must
present their badge to the DPS Airport Security Officer or DPS authorized representative for validation.

3. A person issued an Airport Identification/Access Badge with "access" authorization but does not have the badge in their possession or a person issued a badge without "access" authorization shall not be permitted to enter the AOA through a Terminal Security Gate even under escort.

4. A person who does not possess a valid Airport Identification/Access Badge or has not been issued a badge may be allowed to enter the AOA through a Terminal Security Gate only on official business and only when under escort. The non-badged individual will be documented on a visitor’s log along with the authorized individual conducting the escort and must also have a valid government issued photo identification on their person at all times.

5. The maximum ratio for escorting individuals within the CTA will be one (1) Airport Identification/Access Badge individual with escort authority to five (5) non-badged individuals. Non-badged individuals must remain within visual and physical proximity to the badge holder and also must have valid government issued photo identification on their person at all times.

6. No one will be permitted to enter a Terminal Security Vehicle Gate on foot. All persons and property are subject to inspection by security personnel.

NOTE: Violations of AOA security requirements within Contractor controlled areas of responsibility, which result in criminal or civil penalties, or fines shall be the responsibility of the Contractor and/or individual to resolve or pay, and may result in the temporary or permanent suspension of the Airport Identification/Access Badge.

M. For AOA access and/or construction activities in the west airfield, all badged personnel shall successfully complete the West Cargo Area training program. Upon completion of the training, each badge holder must request the West Cargo Matrix be added to their badge access through the authorized signatory.

1.11 AIRPORT IDENTIFICATION/ACCESS BADGE

A. No person shall enter the SIDA/AOA without authorization. Any person found on the SIDA/AOA without proper identification as described herein shall be considered unauthorized, removed from the SIDA/AOA, and subject to prosecution and suspension or revocation of the Airport Identification/Access Badge.

B. All persons authorized access to the SIDA/AOA shall clearly display a valid Airport Identification/Access Badge issued by the Airport on their outer garment, above the waist and below the neck or shall be escorted by an authorized agent of the Airport, the FAA, or a representative of the airline or tenant.

C. It is the responsibility of every Airport Identification/Access Badge holder to challenge anyone on the SIDA who does not have a valid Airport Identification/Access Badge prominently displayed unless that individual is obviously under proper authorized escort.

D. The ACO administers Airport Identification/Access Badges and is managed by the DPS: The Airport Identification/Access Badge is an easily identifiable badge, about the size of a standard credit card. It must be prominently displayed on the outermost garment above the waist and below the neck of the person to whom it was issued.
E. Applications

1. New applications for an Airport Identification/Access Badge shall be submitted in the manner prescribed by the ACO and coordinated with the OAR. Copies of the application may be obtained from the OAR. Instructions for filling out the form are on the back of the form. Care should be followed in filling out the application.

2. Each applicant must submit to a criminal history records check through submission of fingerprints to the FBI. In addition, each applicant must receive an “Approved” Security Threat Assessment (STA) result from the TSA prior to badge issuance. Those persons who have been convicted of a disqualifying crime and/or who do not receive an “Approved” STA result from the TSA per CFR 1542 shall be denied a badge.

3. Upon approval of the Airport, the application shall be submitted on-line to the ACO located at Terminal D, on the departure level, between Gates 19 and 22.

4. The fees for fingerprinting and the Airport Identification/Access Badge shall be per the current Schedule of Charges.

F. Revocation


2. Upon termination or upon conclusion of the requirement to access the SIDA, the employees of the Contractor shall be responsible for immediately surrendering the Airport Identification/Access Badge to the authorized signatory.

3. The Contractor shall be billed a non-returned badge fee for all badges not returned to the ACO within ten (10) Working Days from the date the ACO is notified of the termination of access privileges.

4. DPS and the badge holder’s sponsor have authority to revoke an Airport Identification/Access badge. If an individual’s Airport Identification/Access Badge is revoked, the person will be immediately escorted from the SIDA/AOA or detained by DPS.

G. Authority

1. The authority to produce and issue an Airport Identification/Access Badge lies solely with the Airport.

2. No person shall produce, copy, issue, or use a similar badge at the Airport.

3. No person shall in any way alter an Airport Identification/Access Badge.

4. The Airport Identification/Access Badge is the sole property of the Airport and issued for the exclusive use of the individual identified thereon.

5. The Airport Identification/Access Badge must be surrendered for inspection upon request of an authorized agent of the Airport.

1.12 AIR OPERATIONS AREA ACCESS PERMIT

A. No motor vehicle shall enter the AOA unless such vehicle displays an AOA Access Permit or is under escort by a duly authorized agent of the Airport, the FAA, or tenant responsible for the AOA gate through which the person is to enter.
B. The ACO administers Access Permits for the AOA.

C. A permanent Access Permit is an easily identifiable decal affixed to the left front and rear bumpers of the vehicle to which the permit has been issued and is valid for a maximum of three (3) years. It displays the permit number and expiration date.

1. A temporary permit is a green colored hanging card placed on the rear-view mirror of the vehicle to which the permit has been issued. A temporary permit is not transferable to another vehicle. This permit is valid for a specific period of time up to 90 Calendar Days, and contains the following information:
   a. Vehicle license plate number
   b. Expiration date
   c. AOA rules

2. Applications
   a. An application for an Access Permit shall be submitted in the manner prescribed by the DPS and coordinated with the OAR. Copies of the application may be obtained from the OAR or the DPS webpage at: https://www.dfwairport.com/badge/
   b. An application for an Access Permit approved by the sponsoring Airport department shall be submitted to the ACO for issuance. Note: Contact the Airport Risk Management Office for insurance requirements necessary to obtain a vehicle permit.

3. Revocation
   a. Violation of the AOA Rules and Regulations is grounds for immediate revocation of AOA vehicle access authority.
   b. Upon termination or upon conclusion of the requirement to access the AOA, the employer/holder shall be responsible for surrendering the Access Permit to the Airport.

4. Authority
   a. The authority to produce and issue an Access Permit lies solely with the Airport.
   b. No person shall produce, copy, issue or use a similar permit at the Airport.
   c. No person shall in any way alter an Access Permit.
   d. An Access Permit is issued for the exclusive use of the vehicle identified on the permit application.

1.13 MOTOR VEHICLES ON AOA

A. Authorization and Registration of Vehicles

1. No motorized vehicle shall enter the AOA unless its driver thereof is duly authorized to operate such vehicle on state or municipal highways and has duly authorized access to the AOA/SIDA (if required). All persons authorized unescorted access to the AOA/SIDA shall display an Airport Identification/Access Badge issued by the Airport.
2. No motorized vehicle shall enter the AOA unless such vehicle displays an Access Permit issued by the Airport, or is under proper escort.

3. All traffic within the AOA shall comply with all lawful orders, signals, or directions of any authorized agent of the Airport. When signs or pavement markings control such traffic, they shall be obeyed unless otherwise directed by an authorized agent of the Airport.

B. Safe Operation of Vehicles:

1. No vehicle shall be operated within the AOA in a careless or negligent manner, in disregard of the rights and safety of others, at a speed or in a manner which endangers persons or property, while the driver thereof is under the influence of an intoxicant, or if such vehicle is so loaded or poorly maintained as to endanger persons or property.

2. Prior to driving within the AOA, the vehicle operator must complete the Airport Driver Training Program on AOA Awareness and/or Nonmovement Area driving. For activities in the west airfield, the vehicle operator must also complete the West Cargo Area driver's training.

3. Night or Low Visibility Operations: For night or low visibility operation, all headlights, tail lights, and running or clearance lights on the vehicle shall be operational. The driver of each vehicle shall be responsible for the proper operation of such lights. During SMGCS conditions (visibility less than 1,200 feet visibility) there may be restrictions on the use of vehicles on the AOA. Vehicles not directly in support of aircraft operations will not be allowed access to the AMA; and non-essential vehicles in support of aircraft operations should not be operated on Ramps and aircraft parking areas.

4. Vehicles to Stay to the Right: All vehicles on the AOA shall remain on the right side of a roadway, shall pass any vehicle approaching on an open unmarked traffic area to the right, and shall yield the right-of-way to vehicles approaching from the driver's right unless otherwise directed by sign, signal, or an authorized agent of the Airport or when necessary to maintain the safe operation of the vehicle relative to traffic flows.

5. Vehicle Speed:
   a. The maximum speed limit on all AOA Ramps is 20 mph and is enforced by the DPS.
   b. Vehicles operating on the Ramps, Aprons, and operational areas of the Airport shall proceed with care. Erratic driving and excess speeds on these areas are forbidden. Judgment of such excess speed or erratic driving shall lie with the DPS, Airfield Operations, the OAR, and other authorized agents of the Airport.

6. Involvement of Vehicles in Accidents:

   The driver of any vehicle involved in an accident within the AOA, which results in injury or death to any person or damage to any property, shall stop at the scene of the accident and render such assistance as may be needed. The driver shall also provide his or her name, address, and operator's license number to the person injured or to the representative of the owner of the property damaged or to any officer or witness of the injury. Further, the operator shall immediately notify the AOC and submit a report of that accident.
to the DPS.

7. Parking Vehicles:
   a. No person shall park a vehicle or permit the same to remain in the AOA except at such places and for such a period of time as may be prescribed or permitted by the Airport or under emergency conditions.
   b. No person shall stop or park a vehicle so as to block a driveway, an AOA gate, an aircraft gate or a fire lane, or in other than authorized areas or within 15 feet of a fire hydrant.

8. Right-of-Way:
   All motor vehicles on the AOA shall yield the right-of-way to aircraft in motion under all conditions, and all Airport vehicles have right-of-way over Contractor vehicles.

C. Prohibited Vehicles:
   1. The use of motorcycles, bicycles, and two-wheeled motor scooters on the AOA is prohibited. EXCEPTION: DPS vehicles.
   2. Vehicles that are not in sound mechanical order with adequate lights, horn, brakes, and have clear vision from the driver's seat are prohibited from operating on the AOA.
   3. Trailers and semi-trailers shall be equipped with proper brakes so that when disengaged from towing vehicle, neither aircraft engine blast nor wind shall cause them to become free rolling. Positive couplings shall be required for all towed equipment.
   4. Vehicles that have not obtained specific authorization from Airfield Operations are prohibited from operating on active portions of the AMA. When authorized, vehicles shall have a radio transceiver or shall be escorted by a vehicle with such equipment to ensure clear two-way radio communication with the Control Tower, and all operators shall have had successfully passed ground vehicle operator training prior to operating vehicles on the AMA.

D. Driving Under Aircraft: It is prohibited to drive under any portion of an aircraft.

E. Taxiway: At no time shall a vehicle enter an active Taxiway, unless it is operated by an AMA trained and qualified driver and appropriately equipped, or accompanied or directed by a radio-equipped vehicle in contact with, and has been so authorized by the FAA Tower.

F. Runway: At no time shall a vehicle enter a Runway, unless it is accompanied or directed by a radio-equipped vehicle in contact with, and has been so authorized by the FAA Tower.

G. Taxiway: At no time shall a vehicle enter an active Taxiway, unless it is operated by an AMA trained and qualified driver and appropriately equipped, or accompanied or directed by a radio-equipped vehicle in contact with, and has been so authorized by the FAA Tower.

H. Runway: At no time shall a vehicle enter a Runway, unless it is accompanied or directed by a radio-equipped vehicle in contact with, and has been so authorized by the FAA Tower.
I. Driving between Aircraft and Loading Gate: No Person shall drive any vehicle between an aircraft and a loading gate, when passengers are using the surface walkway between such gate and aircraft, or between an aircraft signal person and an aircraft being pushed out or preparing to taxi.

J. Driving Distance from Exhaust: Modern, large jet aircraft produce exhaust velocities that can be hazardous to vehicle operations as much as 70 feet behind the aircraft at idle thrust. At the thrust levels required for an aircraft to start moving from a stop, that distance increases to as much as 300 feet. Therefore, extreme caution must always be exercised whenever passing behind large jet aircraft.

K. Fueling or De-fueling of Vehicles:

No person shall fuel or de-fuel vehicles, or other equipment, in an enclosed space at the Airport without the prior approval of the DPS Fire Prevention Bureau.

L. Special Vehicle Marking:

Vehicles operating on a Runway or Taxiway that do not require an escort must display an amber-rotating beacon.

1.14 ENFORCEMENT OF AOA PROCEDURES

Violations of any of these procedures may, at the discretion of the Vice President of Operations (Vice President of Public Safety for regulatory statutes, i.e. Airport Rules & Regulations) or his/her designated representative(s) and depending on the severity of the violation, result in the following:

A. A verbal and/or written warning.

B. The individual or vehicle in violation being temporarily or permanently removed from the AOA.

C. The Contract work being stopped until corrective measures are taken to preclude a recurrence of the violations.

D. Civil and/or criminal penalties per applicable local, state, and federal laws and the Code of Rules and Regulations.

1.15 RULES AND REGULATIONS FOR THE CONTROL OF AOA BOUNDARY CROSSING BY VEHICLES

A. General Requirements

1. Statement of Policy: It is the policy of the Airport that all vehicles, unless otherwise authorized herein, shall enter and exit the AOA via established gates.

2. Authority for Enforcement: The Vice President of Public Safety is designated the Administrator of the Code of Rules and Regulations (Administrator) for the control of AOA boundary crossings. He/she may establish procedures not inconsistent with the Code of Rules and Regulations that he/she determines are necessary to affect the policy of the Code of Rules and Regulations. The DPS shall be responsible for the enforcement of the Code of Rules and Regulations.

B. Enforcement of AOA Boundary Crossing Regulations

1. Violations
a. If the Administrator determines that a badge holder violates terms of its operating authority, the Code of Rules and Regulations, the Administrator may notify the holder in writing of the violation and by written order direct the holder to correct the violation within a reasonable period of time. In setting the time for correction, the Administrator shall consider the nature of the violation.

b. If the violation involves equipment that is unsafe or functioning improperly, the Administrator or his/her authorized agent shall order the holder to immediately cease use of the equipment.

c. If the Administrator determines that a violation is an imminent and serious threat to the public health or safety, the Administrator or his/her authorized agent shall order the holder to correct the violation immediately. If the holder fails to comply, the Administrator shall promptly take, or cause to be taken, any action considered necessary for the immediate enforcement of the order.

2. The Administrator shall include in a notice issued under this subsection:
   a. An identification of the violation;
   b. The date of issuance of the notice;
   c. The time period within which the violation must be corrected;
   d. A warning that failure to comply with the order may result in suspension or revocation of operating authority; and
   e. A statement indicating that the order may be appealed to the Executive Vice President Airport Operations.

C. Service of Notice
   1. A holder shall designate and maintain a representative to:
      a. Receive service of notice required under the Code of Rules and Regulations to be given a holder; and
      b. Serve notice required under the Code of Rules and Regulations to be given a driver employed or contracting with a holder.

   2. Notice required under the Rules and Regulations to be given:
      A holder must be personally served by the Administrator or on notice sent by certified United States mail, five (5) day return receipt requested, to the holder or the holder's designated representatives.
      a. A driver must be personally served by the Administrator or notice sent by certified United States mail, to the address last known to the Administrator of the person to be notified, or to the designated representative for the driver.
      b. Service executed in accordance with this subsection constitutes notice to the person to whom the notice is addressed. The date of service for a notice that is mailed is the date of receipt.

D. Appeal
   1. A holder may appeal a correction order issued under subparagraph 1.b. above
or any other action of the Administrator if an appeal is requested in writing not more than fourteen (14) Calendar Days after notice of the order or action is received.

2. The Executive Vice President Airport Operations shall act as the appeal-hearing officer in an appeal hearing under this subsection. The hearing officer shall give the appealing party an opportunity to present evidence and make argument in his/her behalf.

3. The hearing officer may affirm, modify, or reverse all or part of the order of the Administrator.

1.16 SURFACE INCIDENTS AND RUNWAY INCURSIONS

The Contractor shall perform all work in compliance with this Section, and avoid surface incidents and Runway Incursions at all possible cost. Should a surface incident or Runway Incursion occur due to the Contractor’s negligence, it will constitute a violation and shall be subject to enforcement per subsection 1.14. Entry into the AMA without a CMAE or authorized Airport provided escort and AOA Construction Escort Release/Pick Up Point Instruction Card or without clear instruction/direction from a flag person at a controlled intersection are examples of violations.

Course of action for such occurrence includes a monetary fine of $30,000 for each occurrence.

A. Definitions

1. Surface Incident is an unauthorized or unapproved movement within the designated movement area (excluding Runway Incursions) or an occurrence in that same area associated with the operation of an aircraft that affects or could affect the safety of flight. Examples include, but are not limited to, not yielding right-of-way to aircraft; entering a Taxiway when not qualified, under escort, or directed by a flag person; or depositing debris on a Taxiway resulting in a stopped or damaged aircraft.

2. Runway Incursion is any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft. Examples include, but are not limited to, crossing the Runway holding position marking or entering the RSA from the grassy area regardless of whether or not an active aircraft operation was taking place at the time.

B. An AOA Incident Review Board, chaired by the Vice President of Operations or his/her authorized designee will review the facts surrounding movement area surface incidents and/or Runway Incursions including the affected Contractor and/or department’s policies and procedures.

C. The Review Board’s recommendation(s) will be coordinated with the Human Resources advisor (if required), and a decision as to the level of disciplinary action to be taken per Airport Board Policy will be made by the Chairman.

D. The Chairman will notify the affected Contractor and/or department vice president of the disciplinary action to be administered.

1.17 SURFACE INCIDENTS AND RUNWAY INCURSIONS PREVENTION BONUS
A Project monetary bonus incentive in the amount of $50,000 ("Surface Incidents and Runway Incursions Prevention Bonus") may be added to the monies owed the Contractor under the Contract, should the Project be completed without any surface incident and Runway Incursion within the Contract Time and the option is included in the Contract Documents. Under no circumstances will the Contractor be due or the Airport be liable for such bonus incentive if any surface incident or Runway Incursion occurs, or if the Project is delayed.

PART 2 – PRODUCTS
Not Used.

PART 3 – EXECUTION
Not Used.

PART 4 – MEASUREMENT AND PAYMENT
Not Used.

- END OF SECTION -
PART 1 – GENERAL

A. This Section provides the forms and instructions provided for the Contractor’s use, as applicable, for performing the Work of the Project in coordination with Section 01 35 13.13.

1. Contractor’s AOA Readiness Checklist
2. Lockout Procedure for Airfield Series Lighting Circuits
3. Lockout Log for Airfield Series Lighting Circuits
4. Airfield Closure/Activity/Circuit Lockout Request Form
5. Airfield Closure/Activity/Circuit Lockout Instructions
6. Airport Construction Security Procedures Tool Management Plan
7. Escort Release/Pick up Point Notice/Instructions
8. Airport Airspace Review Form
CONTRACTOR’S AOA READINESS CHECKLIST
(TO BE COMPLETED DAILY BY THE CONTRACTOR)

________ Limits of Closure have been clearly identified to all Contractor and subcontractor personnel. Sufficient quantities of closure devices (red flashers, cones, barricades, etc.) are on hand to achieve the day’s closure. Contractor has sufficient cones, lights, and appropriate flags to identify the Release/Pick up Point within their work area.

________ Electrician is standing by for circuit lockouts and appropriate circuits have been identified (if applicable).

________ All Contractor vehicles entering the AOA have been checked for valid AOA access stickers on driver’s side (left) bumper.

________ All vehicles are equipped with 360 degree rotating or flashing amber beacons and all beacons are in working order.

________ All vehicles have company name clearly identified on driver’s side door.

________ All AOA badged personnel have badges clearly displayed on their person.

________ All non-AOA badged personnel have a government-issued identification on their person.

________ All construction equipment and heavy trucks (non-passenger vehicles) have orange and white checkered flags or 360 degree rotating or flashing amber beacons affixed to the highest point.

________ Superintendent and QC Supervisor have full set of the Contract Documents, including Plans, Specifications, any Project Addenda, construction permit copy, safety plan, SWPPP copy, approved submittals and Request for Information in their vehicles and available at all times on the Project site. Additional supplies for the Superintendent shall include, but not be limited to, fire extinguisher, and first aid kit.

________ All foremen and lead men shall have, at a minimum, all drawing sheets and specifications related to their specific area of work on hand.

________ Contractor has verified that all small engine equipment and tools (generators, saws, etc.) necessary for the day’s activities are on hand and operable.

________ Contractor has verified that all necessary manpower, tools, equipment, and materials necessary for the day’s activities are on hand and operable.

The purpose of this checklist is to reduce or eliminate the number of superfluous trips to and from the job site that generally are a result of a lack of initial preparedness. Contractor’s QC representative will initial each item as it is verified and sign at the bottom when verification is complete. The Board’s authorized representative will not call for Operations Escort or circuit lockouts until checklist has been completed each Working Day. This checklist should be attached to the Contractor’s Daily Activity Report and submitted to the Owner’s Authorized Representative.

Contractor’s Authorized Representative signature ____________________ Date: ___________

Owner’s Authorized Representative signature ____________________ Date: ___________

Page 1 of 1
LOCKOUT PROCEDURE FOR AIRFIELD SERIES LIGHTING CIRCUITS

1. Purpose: The purpose of this procedure is to provide practical safeguarding of all persons directly or indirectly involved in the installation, operation, construction, or maintenance of the airfield series lighting system at the Airport. This procedure contains the minimum provisions necessary to insure the safety of Airport employees and Contractors.

2. Definitions and Abbreviations

   A. AM - abbreviation for "Airport Asset Management".
   B. AOA - abbreviation for "Air Operations Area".
   C. CCR - Coordination Center Representative (Airfield Operations Officer) - the central point of contact for submittal of all AOA scheduled lockout requests; including DCC projects, in-house construction projects, tenant alteration projects, and Asset Management projects or repairs. The CCR will notify the AOC Duty Officer and the FAA of scheduled lockout requests.
   D. FAA - abbreviation for "Federal Aviation Administration".
   E. IRMS - abbreviation for "Insulation Resistance Monitoring System".
   F. Lockout - a safety procedure to de-activate series lighting circuits required by Airport authorities to protect the requesting party from the direct or indirect hazards associated with the flow of electrical current through airfield underground cables, connectors, isolation transformers, or other lighting apparatus.
   G. OPS - abbreviation for "Airport Airfield Operations."
   H. Primary Lockout - A required lockout of series lighting circuits when personnel will be working directly on cable, connectors, isolation transformers, or other airfield electrical components which are energized under normal operating conditions.
   I. Safety Lockout - A required precautionary lockout of series lighting circuits when personnel will be involved in construction work activities such as trenching, excavating, or digging in the vicinity of nearby underground airfield lighting circuits.
   J. Un-Locking - a procedure involving the removal of keyed pad locks on disconnect switches to restore the electrical power on series circuits only after satisfactory wiring continuity and insulation integrity have been verified.
   K. Unsatisfactory Test Results - any electrical test measurement deemed unacceptable by AM, which could be indicative of incipient cable insulation failure, an open circuit, dirty connectors, etc.
   L. AOC – abbreviation for “Airport Operations Center.”

3. General Responsibilities

   A. Asset Management shall be responsible for performing and supervising all scheduled circuit lockouts and un-locking. The AM electrical representative (rep) will perform all the insulation resistance tests required to verify the insulation integrity of the airfield lighting cable prior to locking and unlocking series circuits. In the event of "unsatisfactory" test results, the EAM electrical rep shall place an Airport pad lock on
the disconnect switch(s) ahead of the circuit(s) in question, and direct the Owner's Authorized Representative (or Owner's Authorized Representative's in the event of multiple lockouts on one circuit) to immediately investigate the problem and perform all necessary repairs until acceptable test results are obtained.

B. Owner’s Authorized Representative’s will be responsible for initiating all lockout requests for Contractors and required notifications. In the event of work discrepancies during multiple lockouts on one circuit, Owner’s Authorized Representative representatives from each involved project shall agree to first investigate the apparent problem and restore the circuit integrity to a satisfactory level before damage assessment responsibility is ascertained. The Owner’s Authorized Representative shall also initiate and schedule all Contractor work requests to provide first time electrical service to new airfield series lighting circuits.

C. The CCR will be responsible for reviewing and providing Airfield Lockout Summary information to the AOC Duty Officer and the FAA (SOC).

D. Airfield Operations will be responsible for determining if defective circuits must be repaired immediately or if they can remain locked out until necessary repairs can be performed.

E. The CCR shall review all lockout requests for operational conflicts prior to final acceptance.

4. Notification Protocol

A. In order to disconnect the source of electrical power feeding an airfield series lighting circuit(s), the Contractor shall contact his/ her Owner’s Authorized Representative in sufficient time as to comply with the notification requirements. The Contractor shall also identify his/her respective work area in writing to the Owner’s Authorized Representative.

B. Daily lockout and/or un-lock requests shall be submitted in accordance with the instructions on the AOA Closure/Activity/Circuit Lockout Request.

C. If a lockout and/or un-lock is to be scheduled between the hours of 2200 hrs. on Fridays and 2300 hrs. on Sundays, the Owner’s Authorized Representative shall notify the CCR by 1100 hrs. on the second full Working Day prior to a weekend (normally that will be Thursday).

D. If a lockout and/or un-lock is to be scheduled on a Airport recognized holiday between the hours of 2200 hrs. on the night preceding the holiday and 2300 hrs. the holiday night, the Owner’s Authorized Representative shall notify CCR by 1100 hrs. on the second full Working Day prior to holiday.

E. The CCR shall notify the AOC Duty Officer of weekend and holiday lockout/un-lock requests as soon as they become known.

F. The CCR will e-mail or fax the Lockout summary to the AOC Duty Officer and the FAA (MCC) no later than 1500 hrs. each workday. These Lockout requests are for that day's "night lockouts", and for the following day's scheduled "day lockouts".

G. The AOC Duty Officer and the FAA shall notify the CCR immediately if any potential conflicts or problems are detected on the submitted lockout request. Otherwise, the proposed work shall proceed as scheduled.
5. Series Circuit Lockout Procedure: The following procedure applies to all series circuit lockouts, primary or safety type:

   A. Contractor and the Owner’s Authorized Representative will meet the EAM electrical representative at the vault for the lock out.

   Prior to initiating the lockout, the Owner’s Authorized Representative will contact Airfield Operations on OPS “Primary” radio frequency or by calling 3-3121 to verify that the circuit(s) can be locked out as previously scheduled.

   The AM Electrical Representative will de-energize the circuit, and the Contractor will install his lock on the scissors clip, with the appropriate safety tag, locking out the regulator primary disconnect switch. The safety tag will show the name of the Contractor, date, the Owner’s Authorized Representative radio call number, and the telephone number at which the Owner’s Authorized Representative can be reached during the lockout period. The AM Electrical Representative will then “megger” the circuit using the IRMS. The readings will then be entered in the Lockout Log sheet and will be initialed by the Contractor, Owner’s Authorized Representative and AM electrical representative. The AM Electrical Representative then will isolate the two field contacts of the S-1 switch and perform a continuity test on each circuit to be locked out. The plastic insulating pieces used to isolate the field contacts shall remain in place until all required circuits are tested for continuity and released for the requested lockout. The Owner’s Authorized Representative will then contact AM Control and Airfield Operations to confirm that the lockout of the requested series airfield lighting circuits has been successfully executed. The Contractor may then proceed with his work as scheduled.

   Note: In the event of unacceptable continuity test results (less than 100 K-ohms) prior to locking out any series circuit(s), the AM electrical rep shall immediately place an Airport lock on the disconnect switch of the affected circuit(s) which shall remain in place until the problem has been further investigated and resolved by AM.

   B. Whenever operationally acceptable to Airfield Operations, complete circuits shall be locked out. Example: only OET-7A will be affected, but OET-7A, B and C will be locked out.

6. Series Circuit Unlocking Procedure

   A. The Contractor will notify the Owner’s Authorized Representative when they are ready to unlock the series lighting circuits. The Owner’s Authorized Representative will then contact the AOC Duty Officer, who will inform the AM Electrical Representative to meet the Contractor and the Owner's Authorized Representative at the vault. The AM Electrical Representative will perform a continuity test on all affected circuits. If continuity is verified, the AM Electrical Representative will close the applicable S-1 switch(s) and enable the IRMS to obtain updated resistance-to-ground circuit measurements. After circuit integrity has been verified and approved by the AM Electrical Representative, the readings shall be recorded on the Lockout Log (Attached) and initialed by the Contractor, Owner’s Authorized Representative, and AM. The Owner’s
Authorized Representative will then notify the AOC Duty Officer and Airfield Operations that the circuits have been returned to service.

B. At the time of unlocking the circuit(s) and returning them to service, the AM Electrical Representative will compare the most previous resistance of the circuit(s) to the present resistance. It is desirable not to have the present circuit resistance reading less than 50% of the most previous reading, but in no case shall the reading be less than 100 K-ohms. The AM Electrical Representative’s decision is non-disputable.

C. Any reading below 50% of the most previous reading will be reported to the Electric Shop Supervisor for further investigation.

D. All airfield circuits must be unlocked no later than 30 minutes before sunset, unless prior arrangements have been made with OPS.

The Owner’s Authorized Representative will notify the AOC Duty Officer when the circuit is ready to be "re-energized". The AOC Duty Officer will dispatch an electrical rep to witness the required circuit continuity tests by the Contractor and to perform cable insulation resistance-to-ground testing using the IRMS.

7. Unacceptable IRMS Readings During Unlocking

A. When the IRMS indicates unacceptable resistance-to-ground measurements in the course of unlocking series circuits (reading less than 100 K-ohms), the AM Electrical Representative shall record these readings and place an Airport lock on the defective circuit(s) immediately. The Owner’s Authorized Representative shall then coordinate all necessary investigations and repair work with the Contractor to restore circuit integrity and notify Airfield Operations regarding the status of the affected circuit(s). Airfield Operations shall then determine if the circuit(s) must be repaired immediately or if the circuit can remain locked out until necessary repairs can be rendered. The Airport lock shall only be removed after completion of repair work and satisfactory resistance-to-ground readings have been obtained and approved by the AM Electrical Representative.

8. Multiple Contractor Circuit Lockouts in the Same Vault

A. When it is required for different Contractors to share a lockout on the same circuit, the work shall be coordinated through the AM Electrical Representative. Only one primary lockout shall be allowed on each series lighting circuit; however, there may be multiple safety lockouts if approved by the AM Electrical Representative.

B. All circuits with multiple locks shall have an independent lock with a safety tag from each Contractor/Owner’s Authorized Representative installed on the scissors clip provided on the regulator disconnecting means. At no time will these circuits be turned on or tested without the notification and acknowledgement of all parties involved in circuit lockouts. Prior to any testing or energizing circuits, the AM Electrical Representative will contact each Owner’s Authorized Representative currently logged out with a circuit lockout by OPS "Primary" radio frequency for positive confirmation that all personnel under their
direct supervision have been informed of impending circuit testing or energizing. Failure of Owner's Authorized Representative to acknowledge notification shall result in the immediate refusal by the AM Electrical Representative to test, unlock, or energize circuits.

**Note:** Confirmation will be accepted only via OPS "Primary" radio. In the instance where multiple Contractor lockouts occur in the same vault but not on the same circuit, the Owner's Authorized Representative, EAM, and all other parties shall follow the above "Lockout Procedure" (See Paragraph V). However, prior to application of the required test voltage on any circuit(s), the Owner’s Authorized Representative shall, at the direction of the AM Electrical Representative, notify all parties with locked out circuits in that vault and inform them that testing is about to start. This includes other Owner's Authorized Representative, Contractors, the AOC Duty Officer, and OPS. All contacted parties involved in construction activities shall then acknowledge via OPS primary radio frequency that they have received notice of the upcoming circuit testing and that all personnel working under their supervision are "clear".

When all this has transpired, the required circuit testing and unlocking procedure can then proceed.

9. **Energizing and Testing of Circuits for the First Time**

   A. Prior to the energizing and testing of "pristine" series lighting circuits, the following shall occur:

      1. The Contractor shall notify the Owner’s Authorized Representative a minimum of one week in advance of testing or energizing new circuits. The Owner’s Authorized Representative shall then notify the AOC Duty Officer at least three (3) Working Days prior to performing this activity stating the proposed test date and time, circuit(s) designation(s), name of the load(s) to be tested/energized, and circuit(s) location(s) on the airfield clearly identified.

      2. Prior to the actual test/energizing of new series lighting circuits, the Owner’s Authorized Representative shall give proper notification by OPS Primary Radio frequency to all involved parties including other Owner's Authorized Representative, Contractors, the AOC Duty Officer, and Airfield Operations, that the test/energizing is about to occur.

      **Note:** The Contractor shall be held solely responsible for any damages that occur during the testing/energizing of new series circuits as well as any indirect damages that occur where existing circuit components are interfaced in manholes, hand holes, conduit, and airfield lighting apparatus.

10. **AM Lockouts**

    A. AM shall adhere to the above lockout/un-lock procedures during the course of routine daily maintenance and repair of series airfield lighting circuits. In the event of premature cable failure or unplanned outages, AM will provide immediate emergency repair to affected circuits when notified by Airfield Operations. The
emergency repair work performed by AM shall take priority over all previously scheduled Owner's Authorized Representative lockouts for that day/night. Owner's Authorized Representative must then re-submit lockout requests for any circuits superseded by the EAM emergency lockout repair work.

11. Utility Lock Out / Tag Out Procedures

A. Procedures have been established outlining the minimum requirements to be followed for the locking, tagging and trying to prevent injuries by the inadvertent operation of power equipment, the inadvertent opening of valves in pipes, or the energizing of electric circuits. NO work is to be done on any operable equipment until its operation is prevented by appropriate lock out / tag out. The procedures are outlined in Airport Manual “Lock Out / Tag Out & Confined Entry.” Following the appropriate procedures outlined will ensure compliance with the requirements of Federal 29 CFR 1910.147, “Control of Hazardous Energies.”
<table>
<thead>
<tr>
<th>CIRCUIT NUMBER</th>
<th>DATE</th>
<th>TIME</th>
<th>MEGGER READING</th>
<th>CONTRACTOR'S REPRESENTATIVE</th>
<th>FIRM</th>
<th>24 HOUR CONTACT PHONE</th>
<th>ASSET MGMT</th>
<th>DCC or CM REP.</th>
<th>24 HOUR CONTACT PHONE</th>
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COORDINATION CENTER
AIRFIELD CLOSURE / ACTIVITY / CIRCUIT LOCKOUT REQUEST
E-MAIL TO: coordinationcenter@dfairport.com

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<th>Number of Pages:</th>
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<td>Date/Time of Request</td>
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<td>Construction Manager:</td>
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<td>Contractor Phone/Fax:</td>
<td>CM Phone/Radio Call Sign:</td>
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### AOA CLOSURE / ACTIVITY REQUEST

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### CIRCUIT LOCKOUT REQUEST

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Scheduled Activities:

- Additional Requests/Comments:
AIRFIELD CLOSURE/ACTIVITY/CIRCUIT LOCKOUT
INSTRUCTIONS

This form must be submitted by the Owner’s Authorized Representative (OAR) to the Coordination Center Representative (CCR) by 1100 hrs. of the morning preceding nighttime AOA activities/closures/circuit lockouts (1900 to 0700 hrs.) and/or the following day’s daytime activities/closures/circuit lockouts (0700 to 1900 hrs.). For activities/closures on a holiday, daytime on the day following a holiday, Saturday, Sunday and daytime on Monday, the requests must arrive at the Coordination Center by 1100 hrs. on the last workday prior to the holiday or weekend. For circuit lockouts/lockins on weekends between the hours of 2200 hrs. on Fridays and 2300 hrs. on Sundays, or on an Airport recognized holiday between the hours of 2200 hrs. of the night preceding the holiday and 2300 hrs. on the holiday night, the Owner’s Authorized Representative shall notify the CCR of the times the lockouts/lockins are being requested by 1100 hrs. on the second full Working Day prior to a weekend (for weekends that will normally be Thursday).

Either one request covering an entire workday or two requests (on for the nighttime work and one for daytime work) may be submitted. However, no more than one workday’s activities will be included on each form.

NOTE: ALL TIMES ON THIS FORM WILL BE LOCAL 24-HOUR CLOCK TIMES.

- Submitted By: The OAR for the construction activity who has coordinated scheduling and reviewed the request and is emailing this document.
- Revision No.: This is to denote revisions made after initial request. Leave blank on initial request.
- Date/Time of Request: This is the date and time request is made. Example: Nov. 24/1050
- Project Name/Contract No.: Include both the Project Name and Contract Number.
- Contractor: Name of the Contractor (Prime or General).
- Project Manager: Name of individual responsible for Construction Contract.

Note: Any references to the Owner’s Authorized Representative (OAR) may be interpreted to mean the Airport representative for an Airport managed contracts, the staff representative on ADD projects or the FAA authorized representative for FAA managed projects, etc.

- Contractor Phone/Fax: 24-hour telephone and Fax numbers of the contractor.
- Owner’s Authorized Representative. Phone/Radio Call Sign: Telephone number and Radio Call Sign of the responsible Owner’s Authorized Representative that will be on site during the actual work activity.
- From/To: Enter the date (month and day) and times the activity/closure/circuit(s) lock out is scheduled to occur using a 24-hour clock. Example: 2/23/2245 & 2/24/0645
- Closure/Activity Area: Describe the area affected. When no closure is being requested, "No Closure" should be noted along with the description of the area.
- Circuit(s): List the individual circuits requested to be locked out. Example: ET-13, OWT-7B, etc.

- Scheduled Activities: A brief description of intended activities to be conducted during the period of the request(s) specifically identifying the work requiring closures/lockouts and any excavation/trenching activities. An airfield diagram or other suitable drawing depicting the area of work shall be submitted whenever complex closures are requested.

- Additional Request/Comments: This is a general-purpose section where unique requirements can be requested such as requests for weekend and/or holiday circuit lockouts and/or lock-ins, or specific comments of explanation made which would be useful to the addressees.

NOTE: The telephone number for the CCR is 972-973-3121. The OAR will retain responsibility for ensuring contract compliance, project scheduling and coordination, communications between the Contract and the Airport Operations Dept. and the Airport Maintenance Dept. The CCR will not resolve any Contract and technical disputes. All situations relating to problems with electrical circuitry or the Airport's operational requirements shall be handled between the affected Airport Departments, OAR, or Contractor's Authorized Representative (CAR) responsible for the Project.
AIRPORT CONSTRUCTION SECURITY PROCEDURES
TOOL MANAGEMENT PLAN

Date: __________________________________________________________________________

Project Name: ____________________________________________________________________

Permit Number: __________________________________________________________________

Terminal: ________________________________________________________________________

Columns & Lines: __________________________________________________________________

Contact Name & Phone Number: _______________________________________________________________________

Additional Information: ___________________________________________________________________

______________________________________________________________________________

Contractor’s Signature & Title: _____________________________________________________________________

cc: Airport Police Assistant Chief
Construction Manager
AIRPORT CONSTRUCTION SECURITY PROCEDURES TOOL MANAGEMENT PLAN

The “Tool Management Plan” is for all construction projects that take place in the public areas of terminal concourses (sterile area) to include “back of house” areas such as offices and concessions within the Security Identification Display Area/Air Operations Area (SIDA/AOA). Mobilization of the “Tool Management Plan” must precede all phases of construction and will be enforced for the duration of the project. The following procedures will be implemented.

- Work hours shall be determined by stakeholders, airport development, and the Contractors.
- The Contractor’s Safety/Security Officer is responsible for the implementation and maintenance of the Tool Management Plan.
- The plan will be reviewed with all construction workers prior to each shift.
- The Contractor’s Safety/Security Officer is responsible for the tool box inventory that must be maintained by each sub-Contractor. Each Subcontractor must designate a tool box monitor.
- Consult the “Prohibited Items” list at https://www.tsa.gov/.
- The Contractor’s Safety/Security Officer will prepare the tool box inventory form, which must be completed by each Subcontractor and kept in the tool box at all times.
- Each Subcontractor tool box monitor must also inventory all hand tools brought to the job site by individual workers prior to each shift. This refers to tools carried in the individual’s tool belt or tool bag. The inventory of these tools must be kept in the Subcontractor’s tool box.
- Each Subcontractor will store its inventoried tools in the locked box kept in the secure areas on the ramp, or concourse.
- Unlocked tool boxes must be monitored at all times by the Subcontractor’s tool box monitor.
- All hand tools will be checked out on the tool inventory list to an individual worker by the Subcontractor’s tool box monitor. Each worker is personally responsible for the hand tools he/she checks out.
- Consumables (e.g. razor blades) are included in the tool box inventory, and may be removed from the inventory and disposed of only by the Contractor’s Safety/Security Officer.
- The individual who checked-out a tool must return it to the Subcontractor’s tool box monitor. The tool will be checked-in by the tool box monitor.
- Tools must be kept within five feet of the worker responsible at all times. Unattended tools will be confiscated and returned to the Contractor’s Safety/Security Officer.
- It will be the responsibility of the Subcontractor tool box monitor to reconcile the tool inventory at the conclusion of each shift. The Contractor’s Safety/Security Officer must verify the accuracy of the inventory at the end of each shift prior to workers leaving the job site.
The Subcontractor’s tool box monitor will submit the daily tool box inventory to the Contractor’s Safety/Security Officer who will be responsible for maintaining the permanent document files.

The Contractor’s Safety/Security Officer will submit a summary of the hand tool inventory weekly to the OAR.

If the Contractor’s Safety/Security Officer determines tools are missing at the end of the shift or during a shift, the appropriate authorities will be notified immediately in the following order: Airport DPS Communications at 972-973-3210. Airport Operations Center (AOC) at 972-973-3112.

ZERO TOLERANCE is being observed for any employee who leaves a tool unattended. The offending employee will be escorted from the work site by the Contractor’s Safety/Security Officer and will be removed permanently from the Project.

Airport and/or the Transportation Security Administration (TSA) representatives may randomly monitor the overall construction area at any time and check the tool box inventories.

Work zones that will be established for longer than 24 hours will be separated from the public by barriers or a demising wall.

Existing concourse trash receptacles will not be allowed in the designated construction area. Construction trash receptacles will be provided in the work zone for the disposal of all construction trash. Receptacles must be removed from the work zone at the end of each shift.

The Contractor’s Safety/Security Officer must conduct a security sweep of the construction area at the end of each shift. Airport representatives may participate in the security sweep at their discretion. It is the responsibility of the Contractor’s Safety/Security Officer and Night Superintendent to validate if the security sweep is successful.

Primary access for all employees, tools, equipment, and materials to the construction area will be from the AOA via a DPS manned AOA gate. Employees will be restricted from accessing an employee portal inside the terminals. Employees may access a TSA screening checkpoint; however, NO tools on the TSA prohibited items list are allowed. All vehicles and persons entering the AOA through the designated construction security gate are subject to search.

Employees are restricted to the work area designated by the Contractor’s Safety Officer. The Contractor’s Safety Officer or designee will monitor the work zone to ensure employees do not use public restrooms, concessions, or any other facilities in the concourse. Employees who violate these previsions are subject to removal from the Project. NO EXCEPTIONS.
SIDA BADGE REQUIREMENTS
SIDA/AOA badge requirements will be enforced for all construction employees using the following process.

- SIDA/AOA access badges will be obtained from the Airport Access Control Office located in Terminal D. Information and badge applications are available on the Airport Department of Public Safety web page https://www.dfwairport.com/dps/.
- This process includes fingerprinting, background check and interactive video/testing.
- Non-badged employees will be allowed on the AOA under the following rules only. One badged employee may escort a maximum of five non-badged employees to the AOA/SIDA or Sterile work area. Escorts are not permitted through employee portals. The non-badged employee must have a government issued I.D. in his or her possession. The badged employee’s responsibility will be to continuously monitor and remain in physical proximity of the non-badged employees such that they can control or direct the activity of the non-badged employees at all times.
- **The AOA Badge must be visibly displayed on the outer garment and above the waist at all times while the employee is in the construction area or on the AOA.**

PROCEDURES IN NONPUBLIC AREAS
The following procedures will be used in the nonpublic area of the terminal construction areas.

- Tools used over the long term may be staged within the construction area in locked boxes. One lock box will be permitted for each trade, to reduce the number of trucks entering the AOA on a daily basis.
- Employees are allowed to wear their personal tool belts and hand carry tools into the construction on a daily basis.
- One truck per day will be allowed to deliver tools to the construction area. Vehicles must be permitted by the Airport to enter the AOA.
- **The CONTRACTOR’S Safety/Security Officer will monitor the construction area on a daily basis.**
FOLLOW YOUR ESCORT UNTIL YOU REACH THIS SET OF CONES. THIS IS THE RELEASE AND PICK UP POINT.

1. Follow your DFW Escort closely to the construction Release point.
2. Yield to Aircraft.
3. If lost or separated, **STOP!**, then call Airport Operations at 972-973-3112

**ALWAYS FOLLOW ESCORT!**

*Effective 12-31-07*
AIRPORT AIRSPACE REVIEW

FAA No. ______________________ DFW No.: ___________________ CA No.: _________
Applicant: _____________________ Contact: ____________________ Phone No.: ______

Project Description
Fixed Temporary* __________ Mobile Temporary* _________ Permanent __________

Construction Schedule
Start Date: ____________________ End Date: ___________________ __

Location
(Indicate in NAD 1983 (Geodetic, Lat./Long.) coordinates and attach location plan and site plan)
A. Latitude _____________________________ E. Perpendicular Dist*** _________________
B. Longitude ____________________________ F. Runway Elevation AMSL_______________
C. Impacted Runway _____________________ G. Site Elevation AMSL _________________
D. Distance from Runway End** ____________ H. Object Elevation AGL_______________

Mitigation Conditions
☐ No Impact ☐ As Noted ☐ FAA RO Study Recommended

Reviewed By:
FAA Airways Facilities _______________________________ Date: ___________________
FAA Air Traffic Control _______________________________ Date: ___________________
Airport Operations Dept. _____________________________ Date: ___________________

* The FAA Regional Office must review temporary structures exceeding 753 ft. AMSL.
** Measured parallel to a Runway from proposed structure to nearest Runway threshold.
*** Measured from proposed structure to the Runway centerline.
The Airport Contacts will be identified in the Pre-Construction Meeting.
## AIRPORT AIRSPACE REVIEW

**CRANE/EQUIPMENT OPERATION AREAS (_________') HEIGHT**

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<th>Coordinate Point</th>
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PART 2 – PRODUCTS
   Not Used.

PART 3 – EXECUTION
   Not Used.

PART 4 – MEASUREMENT AND PAYMENT
   Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY
A. Implement a Quality Control Program to ensure that all work is performed in accordance with the Contract Documents and that substantiating documentation is provided.

1.2 SUBMITTALS
A. Submit Quality Control Program Manual in accordance with PART 3 of this Section.
B. Submit detailed Project Quality Control Program for each Construction Contract.
C. Submit the Contractor’s Quality Control Program to the Owner’s Authorized Representative in Microsoft Word 10 days prior to construction activities.

1.3 QUALITY ASSURANCE
A. The Owner’s Authorized Representative will perform periodic reviews and observations of the implementation of the Contractor’s Quality Control Program. The Owner’s testing and inspection efforts are conducted for the sole purpose of facilitating the Owner’s acceptance of the constructed Work. Contractor retains total responsibility for Work.

PART 2 – PRODUCTS
Not Used.

PART 3 – EXECUTION

3.1 GENERAL
A. Implement a Quality Control Program including review and approval of shop and/or working drawings, inspection of materials and workmanship, and coordinating testing by the Owner’s Materials Testing Agency.
B. Establish and maintain an effective quality control (QC) program in compliance with the Contract Clause titled “Inspection of Construction.” QC consist of plans, procedures, and organization necessary to produce an-end product which complies with the contract requirements. Cover all construction design and construction operations, both onsite and offsite, and be keyed to the proposed construction design and construction sequence. The QC Administrator will be held responsible for the quality of work and is subject to removal by the OAR for non-compliance with the quality requirements specified in the contract. In this context the highest-level manager responsible for the overall construction activities at the site, including quality and production is the project superintendent. The QC Administrator must always maintain a physical presence at the site and is responsible for all Quality Control related activities at the site, except as otherwise acceptable to the OAR.
3.2 OWNER’S AUTHORIZED REPRESENTATIVE’S ROLE
   A. The Owner’s Authorized Representative will approve the Contractor’s Quality Control Program and monitor the activities of the Contractor to ensure its effectiveness and compliance with the stipulations within this Section. The Owner's Authorized Representative review does not relieve the Contractor of responsibility for development and implementation of a Quality Control Program or for full compliance with the provisions of the Contract Documents.

3.3 QUALITY CONTROL PLAN
   A. Submittal:
      1. Submit no later than 10 days after receipt of notice to proceed, the Quality Control (QCP) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." DFW will consider an interim plan for the first 10 days of operation. Construction Design and construction will be permitted to begin only after acceptance of the QC Program or acceptance of an interim plan applicable to the feature of work to be started. Work outside of the accepted interim plan will not be permitted to begin until acceptance of a QC Program or another interim plan containing the additional work.
      2. The Quality Control Program must be approved prior to the commencement of construction activities.

   B. Content of the QC Plan:
      1. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the QC Administrator will implement the three-phase control system for all aspects of the work specified.
      2. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
      3. A copy of the letter to the QC Administrator signed by an authorized official of the firm which describes the responsibilities and delegates enough authority to adequately perform the functions of the QC Administrator, including authority to stop work which is not in compliance with the contract. Letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities will be issued by the QC Administrator. Copies of these letters must be furnished to the DFW.
      4. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.
      5. Reporting procedures, including proposed reporting formats.
      6. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable feature under a section. This list will be agreed upon during the coordination meeting.
C. Organization:

1. Designate one individual as the Quality Control Administrator. The Quality Control Administrator will have responsibility for the implementation of the Quality Control Program for the Contractor on all construction contracts. The Quality Control Administrator shall have full authority to represent the company with respect to quality of the work and the Quality Control Program and shall have no duties assigned other than quality control activities.

   A. Quality Control Administrator shall be a full-time employee and be totally dedicated to quality control. Quality Control Administrator shall refer to construction contract general provisions, Section 100-3 for further details.

2. Provide qualified personnel to inspect the work and perform other Quality Control Program duties as required. Submit the qualifications and work experience of all QC personnel to the Owner’s Authorized Representative for review and approval. Refer to Construction Contract General Provisions, Section 100-3, and Quality Control Organization for further details on qualifications of the Contractor’s Quality Control personnel.

D. Approval:

1. The Owner’s Authorized Representative will review the submission and respond within seven calendar days of receipt. Experience and qualifications will be evaluated on a case-by-case basis to determine acceptability of individuals. If approval is conditional, the Contractor will comply with the direction of the Owner’s Authorized Representative.

2. Once approved, the Quality Control personnel may not be replaced, nor any changes made without prior written consent from the Owner’s Authorized Representative.

E. Activities:

1. Provide personnel to perform the following duties:
   a. Field Activities:
      1. Inspect all field work in progress for compliance with the Contract Documents. Inform the Contractor and the Owner’s Authorized Representative of any work that is in non-compliance immediately.
      2. Document all work activities by completing a Daily Construction Report for every contract day using the Oracle Unifier (Skier) software program as designated by DFW. Provide written reference to the Work that was in non-compliance. In addition, all documentation including but not limited to photos, tickets, quantity sign off etc. within 24hrs of the activity for that day.
3. Arrange for all necessary testing and retesting of work with the Owner’s Materials Testing Agency or the Contractor’s testing laboratory. Witness and review the tests and reports for conformance with the Contract Documents.

4. Formulate work lists for items requiring completion for any interim or substantial completion.

5. Approve all concrete placements using approved concrete placement cards.

6. Note any deficiency discovered, maintain records of all deficiencies and corrective action. Provide prompt notification of any deficiency to the Owner’s Authorized Representative and provide an updated file of the log at the weekly construction update meeting. Enter all deficiency information using the Oracle Unifier (Skier) software program as designated by DFW.

7. Participate in all inspections per General Provisions 100-9 in reference to surveillance by the Engineer (OAR).

8. Participate in all meetings with the (Engineer) Owner’s Authorized Representative as required in the Quality Control Program.

F. Office Activities:

1. Review all submittals for compliance with the Contract Documents. Maintain record of all submittals day using the Oracle Unifier (Skier) software program as designated by DFW.

2. Review as-built conditions on the Contract Documents as per requirements of Section 01 78 39, Project Record Documents.

3. Provide all documentation of the Quality Control Program activities to the Owner’s Authorized Representative.

4. Review Contractor’s pay requests and maintain appropriate documentation for quality and acceptance of work being claimed.

3.4 CONTROL

A. Quality Control is how the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control must be conducted by the QC Administrator for each definable feature of the construction work as follows:

3.4.1 Preparatory Phase

This phase is performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase
includes: The Contractor’s Quality Control Program objectives and stated Documentation and records required for implementing the Quality Control Program

A. A review of each paragraph of applicable specifications, reference codes, and standards. Make available during the preparatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by DFW personnel until final acceptance of the work.

B. Review of the contract drawings.

C. Check to assure that all materials and/or equipment have been tested, submitted, and approved.

D. Review of provisions that have been made to provide required control inspection and testing.

E. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

F. Examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

G. Review of the appropriate activity hazard analysis to assure safety requirements are met.

H. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

I. Check to ensure that the portion of the plan for the work to be performed has been accepted by the OAR.

J. Discussion of the initial control phase.

K. The OAR must be notified at least 48 hours in advance of beginning the preparatory control phase. Include a meeting conducted by the QC Administrator and attended by the superintendent, other QC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the preparatory phase actions by separate minutes prepared by the QC Administrator and attach to the daily QC report. Instruct applicable workers as to the acceptable level of workmanship required to meet contract specifications.

3.4.2 Initial Phase

This phase is performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase includes:

A. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

B. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

C. Establish a level of workmanship and verify that it meets acceptable workmanship standards. Compare with required sample panels as appropriate.

D. Resolve all differences.

E. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
F. The OAR must be notified at least 48 hours prior to the beginning the initial phase. Prepare separate minutes of this phase by the QC Administrator and attach to the daily QC report. Indicate the exact location of initial phase for future.

G. The initial phase should be repeated for each work site, or any time acceptable specified quality standards are not being met.

3.4.3 Follow-Up Phase

Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the feature of work. Record the checks in the QC documentation. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work.

3.4.4 Additional Preparatory and Initial Phase

Conduct additional preparatory and initial phases on the same definable features of work if: The quality of on-going work is unacceptable; if there are changes in the applicable QC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.4.5 Sample Forms

A. As required per Technical and General Provisions

3.4.6 Notification of Noncompliance

The OAR and or QC Administrator will notify the Contractor of any detected noncompliance with foregoing requirements. Take immediate corrective action after receipt of such notice. Any notice, when delivered by the Engineer or his/her authorized representative (OAR) at the site of the work, shall be considered sufficient notice. If the Contractor fails or refuses to comply immediately, the OAR may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such orders will be made the subject of the claim extension of time or for excess costs or damages by the Contractor.

3.5 QUALITY CONTROL PROGRAM

A. Prepare a Project Specific Quality Control Program that shall be neatly organized, typed, and shall include but not be limited to the following:

1. The Contractor’s Quality Control Program objectives and stated policy.
2. Organization and delegation of Quality Control authority to various Contractors’ representatives.
3. Documentation and records required for implementing the Quality Control Program
4. Reports and forms to be submitted.
5. Inspections requirements, arrangements, coordination, control and reporting.
6. Testing requirements by the Contractor and required coordination with the Owner’s Materials Testing Agency.
7. Internal audits to ensure the personnel of the Contractor and subcontractors are completing tasks per Quality Control Program
8. Procedures for indoctrination and training of employees.
9. Procedures for receiving and storage of permanent materials for the Quality Control Program.
10. Identify the Quality Control Administrator to be assigned to the project
11. Identify the Quality Control Technicians to be assigned to the project.
12. Organization and delegation of Quality Control authority to various Contractors’ representatives.
13. Tabulation of all tests and inspections anticipated for the Project, and the anticipated schedule for these tests.
14. Specific documentation and records that are required for implementing the Quality Control Manual/Plan for the Project.

3.6 FAILURE TO PROVIDE QUALITY MANAGEMENT SERVICES
A. Repeated failures to comply with the requirements herein may result in the Owner’s Authorized Representative implementing their own Quality Control Program. Such action will be at the sole discretion of the Owner’s Authorized Representative. Cost for implementing the Quality Control Program will be deducted from the Contract Price.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY
This Section covers the use of a Non-Conformance Report (NCR) to document Contractor deviations, deficiencies, and other non-conformance items noted by the Owner’s personnel on the Project.

1.2 DOCUMENTATION
A. All notifications, documentation, and transmittals between the Contractor and the Owner’s personnel for the NCR process shall utilize the Skire Unifier software application, unless an alternate form of transmission is directed by the Owner for the Project.
B. If an alternate form of transmission is directed for the Project, all notifications, documentation, and transmittals shall utilize that form of transmission.

PART 2 - PRODUCTS
Not Used.

PART 3 - EXECUTION

3.1 INSPECTION
A. The CM, Inspector, and other Owner’s personnel will review, observe, and inspect the Work of the Project throughout construction.
B. When a deviation or non-conformance is observed or noted, the non-conformance will be documented by preparing an NCR identifying the non-conformance along with all pertinent information such as location, description, time/date identified, and the reference Specification Section.
C. The CM will notify the Contractor of the NCR.

3.2 CORRECTIVE ACTION
A. The Contractor shall review the NCR and determine what type of Corrective Action is proposed to eliminate the deviation or non-conformance to the Contract Documents.
B. The Contractor shall notify the CM of the proposed Corrective Action to resolve the deviation or non-conformance along with all supporting documentation for review and approval.
C. The CM will review the Corrective Action proposed by the Contractor and may forward the Contractor’s response to the Architect/Engineer and other Owner personnel for input and response.
D. If required, the CM will incorporate the input from the Architect/Engineer and other Owner’s personnel and will forward the response to the Contractor of approval or rejection of the Contractor’s proposed Corrective Action.
E. If the proposed Corrective Action is rejected, the Contractor shall formulate a revised Corrective Action and return the NCR to the CM identifying the revised Corrective Action and all supporting documentation for review and approval.
F. If the proposed Corrective Action is approved, the Contractor shall diligently move forward in incorporating the Corrective Action into the Work and notify the CM when
the Corrective Action is complete and the Work area is ready for follow-up observation, testing, or inspection.

3.3 REINSPECTION

A. Upon notification by the Contractor that the Work is ready for a follow-up observation, testing, or inspection, the CM will schedule the follow-up services to verify the completeness of the Corrective Action and confirmation that the condition is in conformance with the Contract Documents.

B. After the follow-up observation, testing, or inspection is reported to the CM, the CM will close the NCR if the Corrective Action as implemented by the Contractor is approved or notify the Contractor that the end result of the Corrective Action is not in accordance with the Contract Documents.

C. If the Contractor is notified the end result of the Corrective Action is not in accordance with the Contract Documents, the Contractor shall diligently pursue resolution of the NCR through coordination with the CM to determine the cause(s) of non-approval and to repair or reconstruct the Work to remove the non-conformance.

D. Upon completion of the revised Corrective Action, the Contractor shall notify the CM when another follow-up observation, test, or inspection can be performed.

3.4 CLOSURE

A. When the CM is informed by the Inspector or other Owner's personnel that the revised Corrective Action is complete and that the end result of the Corrective Action has removed the deviation or non-conformance, the CM will close the NCR.

B. The CM will sign and date the NCR and notify the Contractor that the NCR has been closed.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY

This Section covers the Contractor’s coordination with the Owner and the Testing Laboratory provided for the Project.

1.2 GENERAL

A. A Testing Laboratory will be provided for the Project at the Owner’s expense. The Owner will contract with an independent entity or consultant to provide the necessary equipment and provide the services to perform the Quality Assurance testing for the Owner as required by the Contract Documents.

B. The Contractor shall coordinate with the Construction Manager (CM) and the Testing Laboratory in collecting or providing the required samples for testing on the Project.

C. The Contractor shall be responsible for all communication between the Contractor, his employees, Subcontractors, and the Owner’s personnel, including the CM, Inspector, and Testing Laboratory personnel in the scheduling times for inspections, tests, obtaining samples and similar activities.

D. The services of the Testing Laboratory shall in no way relieve the Contractor of the obligation to perform the Work in accordance with requirements of the Contract Documents including providing Quality Control testing and monitoring of the Project components.

E. All portions of the Work shall be subject to Quality Assurance inspection in accordance with the Contract Documents and shall remain accessible and exposed for inspection purposes until otherwise approved by the CM.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 TESTING COORDINATION

A. The Contractor shall provide, [on a weekly basis], an anticipated inspection schedule, coordinated with the Construction Schedule, showing the anticipated Quality Assurance inspection needs for the following [three (3) weeks] to facilitate appropriate coordination and mobilization of required personnel.

B. The Contractor shall provide notice to each party at least [two (2) Working Days] prior to any Quality Assurance inspection or testing obligation for modifications from the provided schedule.

C. The Contractor shall coordinate the sequence of activities to accommodate required Quality Assurance observation and testing services with a minimum of delay.

D. The Contractor shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate for any inspections and tests.

E. The Contractor shall provide adequate access of the Owner’s personnel and the Testing Laboratory personnel to the Work so that any Quality Assurance inspection, observation, and/or sample may be obtained from the Work area.

F. The Contractor shall cooperate with the CM, the Testing Laboratory, and any other Owner’s personnel to perform any required Quality Assurance inspection,
observation, test, or similar service, and shall provide reasonable auxiliary service to such parties as requested.

3.2 OWNER TESTING COSTS
A. The Owner will be responsible for the costs of initial Quality Assurance inspections and tests required by the Contract Documents.

3.3 CONTRACTOR TESTING COSTS
A. The Contractor shall be responsible for the costs of any repeat Quality Assurance inspection, observation, or test due to:
   1. Inadequate access existed at the time of the scheduled inspection, observation, or test.
   2. The subject Work area was incomplete or otherwise not prepared or ready when Owner’s personnel, Inspector, or Testing Laboratory personnel arrive.
   3. Failure of the Contractor or a Subcontractor to properly schedule or notify the CM, Inspector, the Testing Laboratory, or any other Owner’s personnel responsible for the Work area or product.
   4. Any change in sources, lots, or suppliers of products after the original test(s) or inspection(s) were completed.
   5. Any changes in the means, methods, techniques, sequences, and procedures of construction that necessitate additional testing, inspection, and related services.
   6. Changes in mix designs for concrete and mortar after review and acceptance of the submitted mix design.
   7. Contractor use of multiple off-site fabrication locations.
   8. Any Contractor, Subcontractor, installation errors, or fabrication errors.
   9. Any inefficient, sporadic, or poorly organized manufacturing that causes additional testing cost to be incurred by the Owner or Owner’s contracted personnel or firm.
   10. The results of a required inspection, test(s), or similar service prove unsatisfactory and do not indicate compliance with the Contract Documents.

B. The Contractor shall be responsible for the costs of all Quality Control testing.

3.4 CONTRACTOR ADDITIONAL TESTING
A. Any additional testing required by the Contractor for determination of construction timing, scheduling, or justification of any discrepancy shall be the sole responsibility of the Contractor.

B. The Contractor shall provide test data an independent testing laboratory to verify materials proposed by the Contractor for a Substitution as stated in Section 01 25 13.

C. The independent testing laboratory shall not be the same entity contracted with the Owner for the Testing Laboratory, inspections, or testing services on the Project.
3.5 LIMITS ON TESTING LABORATORY AUTHORITY
A. The Testing Laboratory may not:
   1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Approve or accept any portion of the Work.
   3. Assume any duties of Contractor.
B. The Testing Laboratory shall have no authority to stop Work.

3.6 REPAIR AND PROTECTION
A. Upon completion of all inspection, testing, obtaining samples, and similar services, the Contractor shall repair any damaged area and restore substrates and finishes to eliminate any deficiency, including visual qualities of exposed finishes.
B. The Contractor shall protect any Work areas exposed for inspection, observation, or testing activities and protect any repaired areas.

PART 4 – MEASUREMENT AND PAYMENT
Not Used.

- END OF SECTION -
PART 1 - GENERAL

1.1 This Section includes the requirements of the temporary facilities and controls required on the Project.
   A. Temporary utilities:
      1. The temporary utilities include providing electrical service, lighting, heating, cooling and ventilation, telephone, water, and sanitary facilities for the Project.
      2. The Temporary facilities may include the use of existing system as applicable.
      3. The Contractor shall be responsible for installation, operation, and maintenance throughout the Project period and removal of the systems at the end of the Project.
   B. The Contractor shall install, remove, and replace temporary construction barricades as required as part of the Work in accordance with the contract documents.
   C. The Contractor shall be responsible for the control of dust on the Project site as well as temporary erosion and pollution controls.

1.2 TEMPORARY UTILITY SERVICE REQUIREMENTS

The Contractor shall provide all the temporary utilities including the following services:
   A. Electrical: Power Source: Current Owner approved Electrical Service provider, Oncor Electric Delivery.
   B. Provide temporary lighting for field offices, storage facilities, shops, Work areas, circulation areas for personnel and other construction areas.
   C. Provide heating, ventilation and cooling:
      1. Maintain temperature, humidity, and ventilation in enclosed areas to provide ambient conditions for storage, preparation, and Work; to cure installed materials, to prevent condensation, and to prevent accumulations of dust, fumes and gases.
      2. During non-working hours, maintain temperature in enclosed areas at a minimum of 50 degrees F or higher as specified in the individual Sections.
   D. Arrange with local telephone service companies to provide and install direct line service to field offices.
   E. Provide water acceptable for use in its intended purpose.
      1. Potable water may be obtained from the Owner’s existing service water facilities. Obtain water at locations approved by Owner’s Authorized Representative (OAR).
      2. Provide the meter(s) required to record amount of water used.
      3. Complete and submit the Water Request Form included in Section 01 50 00.01.
   F. Provide all utilities and associated facilities at time of Mobilization.
1.3 TEMPORARY UTILITY DISTRIBUTION

A. Provide weatherproof distribution boxes with required outlets, fused switches and equipment grounds.
B. Provide wiring, connections, and protection for temporary lighting.
C. Provide wiring, connections, and protection for temporary and permanent equipment for environmental control, for temporary use of electrically operated equipment, and for testing.
D. Provide valve controlled outlets located so that water is available under adequate pressure by means of hoses.

1.4 USE OF EXISTING SYSTEMS

A. The Contractor may use the existing mechanical and electrical systems temporarily and shall coordinate such use with the OAR for terms and conditions for use of systems in Owner occupied areas.
B. The Contractor shall monitor utilities usage to prevent any interference with Owner's normal requirements and notify the OAR of any abnormal usage (volume, pressure, or duration).

1.5 USE OF PERMANENT SYSTEMS

A. If the Contractor wishes to use any Owner permanent system, the Contractor shall obtain written authorization from the Owner for such use and establishing the start of warranty and conditions of use for:
   1. Completed systems with all utility connections and safety devices installed and operational.
   2. Completed systems that operate using automatic controls as required by the Contract Documents.
   3. Filters and other protective devices for the equipment are in place and operational.
B. Submit an Indoor Air Quality Plan to the OAR for review and approval to ensure the use of any Owner permanent system will not negatively impact the Owner's use of the facility. The Contractor shall monitor the continuously monitor conditions to ensure air and water system cleanliness throughout the construction period.
C. Use of Fire Hydrants:
   No person shall open, turn off, interfere with, attach any pipe or hose to or connect anything with any fire hydrant, stop valve, or stop cock, or tap any water main belonging to the Owner, unless authorized to do so by the Central Utilities Plant coordinated through the OAR and have an approved Water Request Form on file.

1.6 COST OF TEMPORARY FACILITIES

A. The Contractor shall pay for the cost of the following:
   1. Permits and inspections unless otherwise provided for in the Contract.
   2. Installation of temporary utilities, materials, operation, maintenance and removal.
3. Energy consumed until beneficial occupancy unless provided for in Contract.
4. Fuel consumed by portable units.
5. Water used throughout the Contract.

NOTE: Water will be billed to Contractor at the rate of $X.XX per 1,000 gallons used.

B. The Owner will pay the cost for the following:
1. Fuel consumed in use of existing systems, except for fuel consumed by portable units.
2. Temporary easements required across property outside the Owner’s property.

1.7 VENDING MACHINES

A. The Owner has exclusive vending contracts in place within the Airport for food, snacks and beverages that pay a substantial sum of money to the Owner on an annual basis. If the Contractor desires to place vending machines on their Project site, the Contractor shall coordinate all requests for placement of vending machines with the Airport Concessions Department through the OAR.

B. Prior to submitting an application to add any other vending source, the Contractor shall first receive a turndown in writing from the primary vending source(s). After receiving a turndown, the Contractor may ask for approval to place other vendor’s equipment on the Project site.

C. No vending equipment may be set-up on the Project site or elsewhere on the Airport prior to receiving the Airport Concessions Department’s written approval from the OAR.

PART 2 - PRODUCTS

2.1 MATERIALS FOR TEMPORARY FACILITIES

The Contractor shall provide the following:

A. New or used materials which are adequate to the intended purpose.

B. All devices and equipment shall meet Underwriter’s Laboratory (UL) requirements.

C. Telephone Equipment: Products of the local service company or specialty devices compatible with service company requirements.

D. Drinking water dispensers of the size and number sufficient to service the Contractor and Owner’s staff. The number and locations of dispensers will be approved by the OAR.

E. Water meter(s) as shown on the Plans which remote reading indicators can be added as a standard option and be equal to those manufactured by Hersey Products, Inc. Only water meter(s) designed to be installed on fire hydrants will be approved for such use.

F. Backflow preventer on all temporary construction water services with a line sized backflow preventer equal to Beeco Model 6-C as shown on the Plans. The Contractor shall install a test valve for facilitating a backflow prevention test.
G. Enclosed portable toilet facilities, self-contained units, secluded from public view meeting the requirements of State and local health regulations and ordinances.

PART 3 – EXECUTION

3.1 TEMPORARY FACILITIES INSTALLATION

The Contractor shall provide the services and facilities as follows:

A. Install initial services and facilities at time of Mobilization.
B. Modify and extend systems as work progresses.
C. Size piping to supply construction needs.
D. Disinfect piping used for drinking water.
E. Test backflow preventer assembly in conformance with Airport Construction and Fire Prevention Standards Resolution (Section 312.9 of the Plumbing Code).

3.2 OPERATION AND MAINTENANCE

A. The Contractor shall operate and maintain the temporary systems to provide continuous service throughout the Project and promptly replace worn or defective parts.

B. Permanent heating, ventilation and cooling:
   1. Clean or replace filters and install filters in duct extensions as necessary to maintain the work areas and finished areas in a condition meeting the requirements of the Contract.
   2. Prior to operation of permanent equipment, the Contractor shall verify that controls and safety devices are complete, equipment has been tested, and inspection made by authorities and approved for operation.
   3. Place zones of permanent HVAC system in operation sequentially as work progresses.
   4. Install temporary filters in air handling units and ducts, replace as necessary to prevent dust in equipment and ducts, to avoid contaminants in work of finished areas as set forth in the approved Indoor Air Quality Plan.

C. Clean sanitary facilities twice per week and maintain in a sanitary condition. Provide all supplies such as toilet paper, paper towels, and soap in suitable dispensers.

D. Dispose of water or sewage in a satisfactory manner so that no nuisance is created and so that the Work under construction will be adequately protected.

3.3 DUST CONTROL

A. The Contractor shall provide positive methods and apply dust control materials to minimize raising dust from construction operations and provide positive means to prevent air-borne dust from dispersing into atmosphere.

B. The Contractor shall maintain dust control measures including, but not limited to, watering down materials to prevent blowing dust/materials and taking necessary actions to abate any nuisance related to excessive dust caused or brought about by the Work to the satisfaction of the OAR.
3.4 EROSION CONTROL
A. The Contractor shall plan and execute construction and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
B. Hold areas of bare soil exposed at one time to a minimum. Provide temporary control measures such as berms, dikes, and drains.
C. Construct fills and waste areas by selective placement to eliminate surface silts or clays, which will erode.
D. Periodically examine earthwork to detect any evidence of erosion, apply corrective measures as required by pollution control in accordance with Section 01 57 13.

3.5 POLLUTION CONTROL
A. The Contractor shall provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by discharge of noxious substances from construction operations.
B. Perform emergency measures required to contain any spillage and to remove contaminated soil or liquids. Excavate and dispose of contaminated earth offsite and replace with suitable compacted fill and topsoil.
C. Prevent harmful substances from entering public waters and the disposal of wastes, effluence, chemicals or other substances adjacent to streams or in sanitary or storm sewers.
D. Provide systems for control of atmospheric pollutants and prevent toxic concentrations of chemicals and harmful dispersal of pollutants into atmosphere.
E. Comply with the Storm Water Pollution Prevention Plan (SWPPP) included in the Plans.

3.6 WASTE DISPOSAL
The Contractor shall dispose of waste throughout the Project in accordance with Section 01 74 19.

3.7 REMOVAL OF TEMPORARY FACILITIES AND CONTROLS
A. The Contractor shall perform the following:
B. Remove the temporary materials and equipment at Substantial Completion of the Project.
C. Restore existing and permanent equipment when used for temporary service to original condition at Substantial Completion.
D. Remove any temporary underground installations to a depth of two (2) feet and grade site as indicated in the Plans.
E. Replace temporary filters with new, clean, reusable filters at Substantial Completion.
F. Remove each water meter at Substantial Completion and leave the water valve in place when the temporary service has been supplied through a water main. Install coat valve and piping remaining with coal tar coating system in accordance with
NAPCA (National Association of Pipe Coating Applicators) TF-2, TF-3, TG-2 or TG-3 specifications.

G. Remove portable toilets when no longer required for the Contractor or Owner’s staff.

PART 4 MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
TEMPORARY FACILITIES AND CONTROLS – WATER REQUEST FORM
Section: 01 50 00.01

DALLAS-FORT WORTH INTERNATIONAL AIRPORT
P. O. Drawer 619428, Dallas-Fort Worth Airport, Texas, 75261-9428,
REQUEST FOR WATER SERVICE

PART I -- TO BE COMPLETED BY THE APPLICANT:

Contract No. Building Permit No.
Contract Title
Applicant's Name
Billing Address
Telephone Number ( ) Fax Number ( )
Authorized Signature of Applicant's Representative:
Date
Meter Location
Size Meter
Service Starting Date Water Line No.
Station No. Fire Hydrant No.
Equipment or Parts Needed

PART II -- TO BE COMPLETED BY THE OWNER:

Date Service: Initiated Terminated
Water Mfg. Serial No.
Register Capacity , Gallons ( ) Cu. Ft. ( )
Extra Equipment

PART III -- INSTRUCTIONS TO APPLICANT

A. Part I of this request should be completed by any party desiring water service from the Owner's water distribution system or who is entitled to the use of the same by contract. Request forms may be obtained by calling Airport utility personnel at (972) 574-6715. Copies of Applicant Instructions and Obligations relative to such services are available upon request at the Central Utilities Plant, Water Services Section.

B. This request shall be returned, with a cashier's check for the amount of $3000 (Three Thousand Dollars), to the Central Utilities Plant, Water Services Section between the hours of 7:00 a.m. - 3:30 p.m.; the check shall be made out to the D/FW International Airport Board. The check shall be held until such time as the applicant has completed the use of the Dallas-Fort Worth Airport Utilities Section facilities and turned over to the Utilities Section all equipment used in good condition. At such time the applicant's check shall be returned to the applicant by the Owner. If any equipment belonging to the D-FW Utilities Section is found to have been damaged while on loan to the applicant, the amount of damages shall be deducted from the check.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY

This Section covers control of dust resulting from construction operations of the Project.

PART 2 – PRODUCTS

2.1 GENERAL

Water to be used for dust control on the Project shall be potable or non-potable water obtained from a source approved by the Owner or as directed by the Owner’s Authorized Representative (OAR) in accordance with the applicable requirements.

PART 3 – EXECUTION

3.1 GENERAL

A. Prior to the start of construction, the Contractor must submit a Dust Control Plan which will describe the means and methods to alleviate and prevent dust nuisance originating from construction operations including but not limited to demolition, earthwork, crushing, haulage and stockpiling operations within the Project limits inclusive of the staging yard. Work shall not commence until the Dust Control Plan has been approved by the OAR.

B. The Contractor will investigate the availability of an adequate supply of suitable water, make all arrangements (including permit if required) for the purchase of the water and provide necessary facilities to furnish water for use during construction, solely at the Contractor’s expense. Water may be obtained from the fire hydrants on Airport property. The availability and quality of the water obtained from these sources is not guaranteed.

C. Any dust control complaints received from tenants, airport users, and or the Airport Operations Department shall require the Contractor to cease dust creating tasks until such time that the dust control measures have been implemented and the issue resolved.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

– END OF SECTION –
PART 1 – GENERAL

1.1 STATEMENT OF POLICY

It is the policy of the Owner to promote adequate and efficient vehicle services and operations at the Airport. To this end, Rules and Regulations for Parking Revenue Area (PRA) use are developed to protect the public health and safety, and promote public convenience and necessity, while minimizing adverse effect on public parking capacity and protection of revenues. Specifically, it is the policy of the Owner that all vehicles, including private vehicles, unless otherwise noted herein, shall enter and exit the PRA via the North and South Control Plazas.

1.2 FORMS

The following permit application links and/or forms have been included with this Section for the Contractor’s use, as applicable:

   The VAT application is an online application that requires a “DFW Connected” account be successfully accomplished. Once the account is set up, the application for a VAT can be submitted online. There are no paper applications for the VAT. The application process for the VAT does not guarantee approval or unit issuance.

B. Parking Revenue Area (PRA) Access Permits Air Operations Area (AOA) Access or Parking Revenue Area (PRA) Access Permits (http://www.dfwairport.com/badge/), then link to the AOA badge option.

C. Airport Identification/Access Badge Application. (http://www.dfwairport.com/badge/), then link to the Identification/Access badge option.

1.3 AUTHORITY FOR ENFORCEMENT

The Airport Vice President Airport Operations (VPAO) is designated as the administrator of the Airport Vehicle Rules and Regulations to control PRA use. The VPAO may, by written order, establish procedures consistent with the Rules and Regulations which he/she determines necessary. The Airport Department of Public Safety (DPS) shall be responsible for the enforcement of the Rules and Regulations.

1.4 OPERATING AUTHORITY

A. Operating Authority Required
   1. A person shall not operate at the Airport utilizing an Ingress/Egress Device described herein without Operating Authority granted under the Code of Rules and Regulations unless the person driving the vehicle, or another who employees or contracts with the driver, has been granted Operating Authority under the Code of Rules and Regulations.

   2. Operating Authority shall not be transferred to another person or vehicle.

B. Application for Operating Authority
   1. To obtain Operating Authority a person shall make application in the manner prescribed by this Section. The applicant must be the person who will own, control, or operate the proposed vehicle. An applicant shall file the appropriate
form, included in the Section 01 55 20.01, with the Approval Authority along with the fee, if required.

2. To obtain Operating Authority a person shall make application in the manner prescribed by this Section. The applicant must be the person who will own, control, or operate the proposed vehicle. An applicant shall file the appropriate form, included in Section 01 55 20.01, with the Approval Authority along with the fee, if required.

3. A separate application shall be submitted for each vehicle for which Operating Authority is being requested.

4. The justification section of each application shall include why the device is needed and the purpose(s) for which it will be used.

C. Renewal of Operating Authority

1. A Holder shall apply for a renewal of his Operating Authority at least thirty (30) Calendar Days before the expiration of the Operating Authority.

2. Within a reasonable time from the date of application, the Approval Authority shall approve or deny the application for renewal.

3. The Approval Authority shall renew the Operating Authority if he/she determines that the Holder has performed satisfactorily under the terms of the Operating Authority and is in compliance with all requirements of the Code of Rules and Regulations.

4. Operating Authority shall be renewed annually.

D. Denial of Application for Issuance or Renewal: Issuance or renewal of Operating Authority shall be denied if the applicant has:

1. Failed to comply with the requirements set forth in the Code of Rules and Regulations; specifically, the information required in the justification section of the application. Need should be stated in terms of function of transportation as well as contract, agreement, permit, or lease provisions to satisfy requirements.

2. Been found in violation twice for failure to comply with the Code of Rules and Regulations within the previous year.

3. Made a false statement as to a material matter in the Application for Operating Authority.

E. Suspension and Revocation of Operating Authority

1. Suspension or revocation of Operating Authority shall occur if the Holder has:
   a. Made a false statement as to a material matter in the Application for Operating Authority.
   b. Failed to comply with provisions of the Code Rules and Regulations or orders established under the Code of Rules and Regulations;
   c. Failed to comply with conditions set forth in the Operating Authority.

2. A Holder’s Operating Authority shall be revoked by confiscation of the device based on unauthorized use. After fourteen (14) Calendar Days the Holder may reapply for Operating Authority; however, the fee shall be escalated to 100% in

Dallas Fort Worth International Airport
Contractor Use of Parking Revenue Area
Standard Specification Book V2

Publish Date December 7, 2018
excess of the original fee paid for the device, or 100% in excess of the replacement fee, whichever is greater.

3. A Holder who’s Operating Authority has been revoked twice for unauthorized use shall not be eligible for reinstatement for a period of twenty-four (24) months from the date of the second revocation.

F. Appeals

1. If an application for issuance or renewal of Operating Authority is denied, suspended or revoked, the action is final unless within ten (10) Working Days from the date of receiving notice of the action, the applicant or Holder files a written appeal with the VPAO.

2. The VPAO or his/her designated representative will act as the appeal-hearing officer in an appeal hearing under this Section. The hearing officer will give the appealing party an opportunity to present evidence and make argument in his behalf.

3. The hearing officer may affirm, modify, or reverse all or part of the action of the Approval Authority being appealed.

G. Fees

1. The Contractor may be granted access to the PRA via either 24 hour free parking status or by issuance of a VAT tag as described in subsection 1.5 of this Section. Current Holders of NTTA Toll tags may utilize those tags in conjunction with 24 hours free parking or in lieu of a VAT device.

2. PRA parking privileges must be applied for or renewed annually upon the beginning of the calendar year.

3. Unless exempted by separate agreement, issuance of VAT tags requires a $100.00 deposit refundable upon device return to the Parking Business Unit (PBU.) This deposit applies only to VAT’s issued by the PBU. Approved applicants who currently hold a Toll Tag from the North Texas Tollway Authority (NTTA) may avoid this deposit by notifying the PBU of the device and utilizing that device rather than a VAT to access the PRA.

1.5 PRA PRIVILEGES AND DEVICE ISSUANCE

A. PRA parking privileges (24 hours free or VAT tags) shall be granted and/or issued based upon business need, as evidenced in the justification presented in the Application for Operating Authority.

B. Vehicle Access Tag (VAT) A VAT is an electronic device assigned to a specific vehicle of authorized Holders that allows passage through Toll Tag lanes at the entry and exit plazas or at crossover gates along International Parkway of the PRA as indicated in subsection 1.7 of this Section. Exit from any other gate requires fees to be assessed in accordance with the Owner’s Schedule of Charges, as amended.

1.6 ENFORCEMENT

A. Violations

1. If the VPAO determines that a Holder violates terms of its Operating Authority or the Code of Rules and Regulations, the VPAO may notify the Holder, in writing, of the violation and by written order may direct the Holder to correct the violation within a reasonable time. In setting the time for correction, the VPAO
will consider the nature of the violation. If the violation involves equipment that is unsafe or functioning improperly, the VPAO will order the Holder to immediately cease use of the equipment.

2. If the VPAO determines that a violation is an imminent and serious threat to the public health or safety, public parking capacity or revenue loss exists, the VPAO will order the Holder to correct the violation immediately. If the Holder fails to comply, the VPAO will promptly take, or cause to be taken, any action he/she considers necessary to the immediate enforcement of the order.

3. The VPAO shall include in a notice issued under this Section:
   a. An identification of the violation;
   b. The date of issuance of the notice;
   c. The time period within which the violation must be corrected;
   d. A warning that failure to comply with the order may result in suspension or revocation of Operating Authority; and
   e. A statement indicating that the order may be appealed to the VPAO.

4. The VPAO may confiscate the Ingress/Egress Devices on the basis of unauthorized use.

B. Service of Notice

1. A Holder shall designate and maintain a representative to:
   a. Receive service of notice required under the Code of Rules and Regulations to be given a Holder; and
   b. Serve notice required under the Code of Rules and Regulations to be given a driver employed by or contracting with a Holder.

2. Notice by the VPAO required under the Code of Rules and Regulations to be given:
   a. A Holder may be personally served or a notice sent by certified mail, five-day return receipt requested, to the Holder or the Holder's designated representatives.
   b. A driver may be personally served or a notice sent by certified United States mail, five-day return receipt requested, to the address last known by the Owner of the person to be notified, or to the designated representative for the drivers.

3. Service executed in accordance with this Section constitutes notice to the person to whom the notice is addressed. The date of service for a notice that is mailed is the date of receipt.

C. Appeal

1. A Holder may appeal a correction order issued under subsection 1.6.A. above or any other action of the VPAO if an appeal is requested in writing not more than fourteen (14) Calendar Days after notice of the order or action is received.

2. The VPAO or his/her designated representative shall act as the appeal-hearing officer in an appeal hearing under this Section. The appeal-hearing officer
shall give the appealing party an opportunity to present evidence and make argument in his behalf.

3. The appeal-hearing officer may affirm, modify, or reverse all or part of the order of the Approval Authority.

1.7 VEHICLE ACCESS TAG INSTRUCTIONS

A. The VAT should be mounted in the center of the vehicle windshield behind the rearview mirror.

B. Replacing of a VAT requires a new application along with a copy of the Police Department theft report, if stolen.

C. VAT-equipped vehicles shall not enter or exit any lanes marked as public only. They may enter or exit any lane marked Public/Toll Tag only.

D. Violation or abuse of VAT or PRA parking privileges shall be subject to confiscation of VAT and/or suspension or revocation of the device or PRA parking privileges in accordance with subsection 1.4 of this Section.

1.8 FEE SCHEDULE

A. Fee shall be as determined by the Owner as per subsection 1.4G of this Section.

B. The charge for a VAT or PRA parking privileges is established in the Airport Board Schedule of Charges.

C. Replacement Fees: The replacement fees have been set to encourage extraordinary care and to deter loss for any reason; however, requests for waiver of replacement fees for lost, stolen or destroyed Ingress/Egress Devices will be considered based on information surrounding the loss furnished to the VPAO in writing.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
AOA Vehicle Permits

An Air Operations Area (AOA) Access Permit is the means by which a motor vehicle is authorized to enter and operate on the AOA and the SIDA. To obtain an Access Permit, complete all requested information on the Air Operations Area Access Permit application or the Temporary Air Operations Area Access Permit in this Section, attach a copy of your company’s Acord Certificate of Liability Insurance as proof of insurance, then take the completed application to an authorized badge sponsor for signature before bringing the application to the Airport Access Control Office (ACO).

The following will help you determine which Access Permit application you need to complete:

1. Select the Air Operations Area Access Permit application when the following conditions apply:
   a. Your company is an airline tenant, government agency, Airport concessionaire or the Airport Board; or
   b. Your company is a contractor or vendor for an airline tenant, government agency, Airport concessionaire or the Airport Board whose contract/agreement expires on the last day of the calendar year (ex. Contract term begins on 05/15/2007 and expires on 12/31/07).

2. Select the Temporary Air Operations Area Access Permit application when the following condition apply:
   a. Your company is a contractor or vendor for an airline tenant, government agency, Airport concessionaire or the Airport Board whose contract/agreement expires prior to the end of the last day of the calendar year (ex. Contract term begins on 01/01/2007 and expires on 09/30/2007)

Please make sure you allow two (2) to three (3) Working Days for application processing and permit issuance. The ACO will contact you via email or telephone when the permits are ready to be picked up.

AOA Vehicle Permit Insurance Requirements

All policies must be written through a licensed company authorized by the Texas State Board of Insurance to transact that class of insurance business in the State of Texas, with a minimum rating of ‘A-’ ‘VII’ by A. M. Best Company. If the rating of any insurer should fall below this standard, you shall cause the policy to be replaced promptly by an acceptable insurer.

Commercial General Liability (CGL) Limit Any One Occurrence ......................... $1,000,000
CGL must be written on an "Occurrence Form."

Business Automobile Liability Combined Single Limit for Each Accident .............. $500,000
Coverage must apply to all vehicles (owned, non-owned, or hired) operating on our site/location, or transporting our people or property off our site.

Excess / Umbrella Liability Air Operations Area (within air operations area)..... $10,000,000
Coverage must apply in excess of all required primary Liability insurance, and must be at least as broad as the underlying Liability insurance.

This coverage limit may be satisfied by adding the amounts of CGL and Excess/Umbrella Liability to arrive at a total of $10,000,000. The same would be applicable for Business Auto Liability and Excess/Umbrella Liability to arrive at a total of $10,000,000.
AIR OPERATIONS AREA ACCESS PERMIT APPLICATION
Department of Public Safety Access Control Office
Terminal D, Room D22L352, 2333 International Parkway, DFW Airport, Texas 75261-0687
Phone: 972 973 5100 Fax: 972 973 5113

Company Name
__________________________________________ ____________________ _________________

Authorized Company Representative
Phone Number
__________________________________________ ____________________ _________________

Company Representative Email Address
Fax Number
__________________________________________ ____________________ _________________

Mailing Address: Street/PO Box City State Zip Code
_____________________________________________________________________________________

Vehicle Information:

License Plate Number State of License Vehicle Unit Number
_____________________________________________________________________________________

Vehicle Model Year Vehicle Make Vehicle Model
_____________________________________________________________________________________

Registered Owner of Vehicle: Last Name First Name
_____________________________________________________________________________________

Owner Mailing Address: Street/PO Box City State Zip Code
_____________________________________________________________________________________

☐ Company Vehicle ☐ Personal Vehicle

☐ Board/Signatory Airline/Government Agency ☐ Concessionaire

☐ Contractor ☐ Delivery Vendor Length of Contract/Agreement: From ___/___/___ To ___/___/___

Justification for AOA Access: ____________________________________________________________
_____________________________________________________________________________________

Authorized Badge Sponsor Signature Signature Code
_________________________________________________ _____________ ________________

Printed Name of Authorized Badge Sponsor
_____________________________________________________________________________________

☐ Proof of insurance attached

Note: Temporary AOA Access Permits must be displayed so that the expiration date is clearly visible through the front
windshield of the vehicle. Violation of the Dallas Fort Worth International Airport Board Code of Rules and Regulations
governing AOA access is grounds for revocation of the AOA Access Permit. AOA Access Permits will not be issued to
vehicles that are not owned and registered to a company.

ACO Authorized Signature Date
__________________________________________________ ____________ ___________________

For Access Control Office Use Only

Permit number: ________________ Permit expiration date: ________________

Date received: ________________ Date issued: ________________ Issued by: ________________
# TEMPORARY AIR OPERATIONS AREA ACCESS PERMIT APPLICATION

**Department of Public Safety Access Control Office**

Terminal D, Room D22L352, 2333 International Parkway, DFW Airport, Texas 75261-0687

Phone: 972 973 5100 Fax: 972 973 5113

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### Company Name

__________________________________________ _____________________________________

Authorized Company Representative  \ Phone Number

__________________________________________ _____________________________________

Company Representative Email Address  \ Fax Number

**Mailing Address:**

<table>
<thead>
<tr>
<th>Street/PO Box</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
</tr>
</thead>
</table>

### Vehicle Information:

<table>
<thead>
<tr>
<th>License Plate Number</th>
<th>State of License</th>
<th>Vehicle Unit Number</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Vehicle Model Year</th>
<th>Vehicle Make</th>
<th>Vehicle Model</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Registered Owner of Vehicle</th>
<th>Last Name</th>
<th>First Name</th>
</tr>
</thead>
</table>

**Owner Mailing Address:**

<table>
<thead>
<tr>
<th>Street/PO Box</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
</tr>
</thead>
</table>

- [ ] Company Vehicle  - [ ] Personal Vehicle
- [ ] Board/Signatory Airline/Government Agency  - [ ] Concessionaire
- [ ] Contractor  - [ ] Delivery Vendor  Length of Contract/Agreement: From ___/___/___ To ___/___/___

### Justification for AOA Access:

_________________________________________________________

---

**Authorized Badge Sponsor Signature**

__________________________________________

Printed Name of Authorized Badge Sponsor

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- [ ] Proof of insurance attached

**Note:** Temporary AOA Access Permits must be displayed so that the expiration date is clearly visible through the front windshield of the vehicle. Violation of the Dallas Fort Worth International Airport Board Code of Rules and Regulations governing AOA access is grounds for revocation of the AOA Access Permit. AOA Access Permits will not be issued to vehicles that are not owned and registered to a company.

**ACO Authorized Signature**

__________________________________________

Date

---

**For Access Control Office Use Only**

 Permit number: ____________  Permit expiration date: ____________

 Date received: ____________ Date issued: ____________ Issued by: ____________

---

**Page 1 of 1**
PART 1 - GENERAL

1.1 SUMMARY

This Section requires the Contractor to provide design and construction information for all oil products temporarily or permanently stored on the Airport. It identifies when a spill prevention control and countermeasure (SPCC) plan is required, and what information is required to update the existing Owner's SPCC.

1.2 SUBMITTALS

The Contractor shall submit the following to the Owner's Authorized Representative (OAR) for review and approval:

A. A Project site specific SPCC plan.
B. An inventory of all permanent oil containers installed or removed on Airport property.

1.3 DEFINITIONS

A. Oil: Oil in any kind or in any form, including but not limited to: fats, oils; greases of animal, fish or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits or kernels; and other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed with wastes other than dredged spoil. Typical petroleum fuels are gasoline, diesel, and jet fuel.

B. Container: Any container used to store oil. These containers are used for purposes including, but not limited to, the storage of oil prior to use, while being used, or prior to further distribution in commerce. Oil-filled electrical, operating, or manufacturing equipment is not a bulk storage container.

1.4 TEMPORARY OIL STORAGE

If during the construction of the Project, oil products will be temporarily transported on the Project site, the following requirements shall be considered by the Contractor:

A. If oil or oil products will be stored in above ground storage containers of 55 gallon size or more with a total onsite storage capacity of 1320 gallons or more during the Project, the Contractor must prepare a SPCC plan.

B. Prior to construction permit approval, the Contractor shall submit to the OAR for the Airport Environmental Affairs Department (EAD) review and approval, construction site specific SPCC plan. The site specific plan shall meet the requirements of Code of Federal Regulations (CFR) Title 40, Part 112, and include at a minimum:

1. An inventory of all oil storage containers on the Project site.
2. The total capacity of each storage container.
3. Type of material stored in each storage container.
4. Design information on secondary containment or diversionary methods utilized in order to prevent release of the materials stored in the containers.

C. The Contractor shall monitor increases or decreases in total oil container capacity throughout the Project.

1. If the total onsite oil container volumes change, or the type of materials change, the Contractor shall amend the site specific SPCC plan and resubmit to the OAR.
2. If the total capacity of onsite oil containers drops below 1320 gallons before the Project closeout, the site specific SPCC plan may be discontinued. The Contractor shall notify the OAR in writing of the changes and obtain written approval from the EAD, through the OAR, to discontinue the site-specific SPCC plan.

D. At the Substantial Completion of the Project, or when otherwise approved by the OAR, the Contractor shall remove all stored materials and clean/correct any spotting or evidence of spills created by the stored materials. Spill removal shall comply with the requirements in Section 01 57 19.13 - Spill Response Plan and Section 01 33 29.06.01 - Contaminated Media Management Plan.

1.5 PERMANENT OIL CONTAINERS

If during construction of the Project, permanent oil containers are installed or removed from the Project site, the following requirements shall be considered by the Contractor:

A. An inventory of permanent oil containers installed or removed shall be submitted to the OAR for the EAD review. The submitted inventory shall include:

1. The capacity of each storage container added or removed
2. The type of materials to be stored in each container
3. Description of the secondary containment or diversionary methods utilized by storage container.

B. The inventory shall be submitted with the environmental close-out checklist prior to Project closeout.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

END OF SECTION -
PART 1 - GENERAL

1.1 SUMMARY

This Section provides the minimum procedures to prevent, prepare for, notify, and respond to any spills during the Project when it involves fuels, oils, paints, chemicals, regulated substances, or other hazardous materials.

1.2 DEFINITIONS

A. Oil or Oil Products: Oil in any kind or in any form, including but not limited to: fats, oils; greases of animal, fish or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits or kernels; and other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed with wastes other than dredged spoil.

B. Oil Spills: Quantities that may be harmful to public health. These include the following types of discharges:
   1. Violate applicable water quality standards.
   2. Cause film or “sheen” upon, or discoloration of the surface of the water or adjoining shorelines.
   3. Cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines.

C. Spill: Any release or discharge from designated/designated containers. Includes, but is not limited to, spilling, leaking, pumping, pouring, emitting, emptying, or dumping of fuels, oils, hazardous materials, air pollutants and/or hazardous waste unless the emission is covered by an applicable permit.

1.3 SUBMITTALS

The Contractor shall submit to the Owner’s Authorized Representative (OAR) the following:

A. A Spill Response Plan (SRP) to be reviewed and approved by the Airport Environmental Affairs Department (EAD) prior to obtaining a building permit.

B. For spills exceeding the reportable quantity for the material, submit a report with the information identified in subsection 2.1(C) within 48 hours of the event.

C. For spills exceeding the reportable quantity for the material, submit a written report with the information identified in subsection 2.2(B) within 25 Calendar Days of the event.

1.4 SPILL RESPONSE PLAN

A. The Spill Response Plan form can be located at:
   https://www.dfwairport.com/cs/groups/webcontent/documents/webasset/p1_021796.doc

B. An SRP shall be provided when the construction of the Project requires the use or storage of fuels, oils, paints, chemicals, and any other material in quantities that may pose a threat to human health or the environment.
C. The Contractor shall review the SRP on a regular basis, and update when any of the following occurs:
   1. Applicable regulations are revised.
   2. The SRP fails in an emergency.
   3. The Project site changes in design, construction, operation, maintenance or other circumstances that materially increase potential for fires, explosions, release of hazardous waste or hazardous waste constituents, or changes response necessary in an emergency.
   4. Change in list of emergency coordinators.
   5. Change in list of emergency equipment.

PART 2 – PRODUCTS
   Not Used.

PART 3 – EXECUTION
3.1 SPILL EVENTS
   A. The Contractor shall report all spills immediately by phone to Airport Operations Center (AOC) at 972-973-3112 and activate the SRP immediately upon discovery of a spill event.
   B. For spills that exceed the reportable quantity for that material, the EAD will notify the Texas Commission on Environmental Quality (TCEQ) and/or National Response Center (NRC) within 24 hours of the event. Provide EAD, through the OAR, the following information as soon as possible:
      1. The name, address, and telephone number of the person reporting and the responsible person.
      2. The date, time, and location of the spill or discharge.
      3. A specific description of the material discharged or spilled.
      4. An estimate of the quantity discharged or spilled.
      5. The duration of the incident.
      6. The name of the surface water or a description of the waters affected or threatened by the discharge or spill.
      7. The source of the discharge or spill.
      8. A description of the extent of actual or potential water pollution or harmful impacts to the environment and an identification of any environmentally sensitive areas or natural resources at risk.
      9. Any known or anticipated health risks.
     10. The identity of any governmental representative responding to the discharge or spill.
     11. Any other information that may be significant to the response action.
C. For spills that exceed the reportable quantity for that material, provide a written report of the information requested in 2.1 (C) to the OAR, within 48-hours of the spill. The EAD will review the report.

D. Manage all waste in accordance with Section 01 74 19.

E. All Contractor caused spills shall be cleaned by the Contractor at his sole expense.

3.2 POST-SPILL ACTIVITIES

A. EAD will determine adequacy of the Contractor’s cleanup activities. If the Contractor fails to cleanup spill to the satisfaction of the EAD, the Owner will separately contract a response crew to clean up the spill and the cost will be deducted from Contract Amount.

B. For spills that exceed the reportable quantity for that material, the Contractor shall provide a written report to the OAR within 25 Calendar Days of the event. The written report shall include the following:

1. A statement that the discharge or spill response action has been completed.
2. A description of how the response action was conducted.
3. The statement shall include the information detailed in subsection 2.1 (C).

C. Additional information as requested by the Owner.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.
Spill Response Plan

Project Name: ____________________________________________________________

Permit Number: __________________________________________________________

General Contractors Name: ________________________________________________

Site Superintendent’s Name and phone number: ________________________________

Start Date: _____________________ End Date: __________________________

Below is the general procedure to follow in the event of a spill or loss of product that results in an impact or potential impact to soil, surface water, groundwater or sanitary sewer system.

Notifications:

- 911 (if immediate danger to life or health)
- Airport Operations Center (AOC) at (972) 973-3112 for all spills no matter what the quantity.
- Environmental Emergency Response Contractor (if necessary).
- For Tenant spills that exceed the reportable quantity contact the Texas Commission on Environmental Quality (TCEQ) at 800-832-8224 and the National Response Center (NRC) at 800-424-8802.
- For Project spills that exceed the reportable quantity contact the Airport Environmental Affairs Department (EAD). The EAD will notify the TCEQ and NRC.
- Construction Manager (CM), and tenant coordinator, as applicable.

Cleanup:

- Impacted media shall be picked up and stored in a waterproof and leak proof container or placed on plastic sheeting and securely covered with plastic sheeting until disposal is arranged.
- The Superintendent or Emergency Response Coordinator will work with EAD and CM to determine the appropriate sampling and disposal protocols for handling impacted media.

Follow-up:

- Within 48 hours of a reportable spill, send a written report to the CM and the EAD describing the cause of the release, the total quantity of material discharged, description of the Corrective Action taken or still in progress to be completed, notifications made, and plans for preventing recurrence.
- Complete any follow-up reports required by the TCEQ or NRC within the allowable time frames and provide copies of all reports to the CM and the EAD.
Project Description:

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

List of Spillable Materials on Project site: (including fluids from heavy equipment, applied materials such as paint, stored chemicals, adhesives, granular materials, admixes)

<table>
<thead>
<tr>
<th>Material (i.e. diesel fuel, paint, hydraulic fluid)</th>
<th>Estimated quantity</th>
<th>Storage location (Where is it stored? i.e. excavator, drum, 5-gallon bucket)</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

Fueling:

Will fueling of vehicles or equipment be done on site? If yes, describe method
______________________________________________________________________

Preparedness:

What spill response equipment and supplies will be maintained on site?

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

Prepared by:

Printed Name
__________________________________________

Signature
__________________________________________

Company
__________________________________________

Date
__________________________________________
PART 1 - GENERAL

1.1 SUMMARY

This Section covers the requirements for the storage, protection, and maintenance of construction materials and storage areas on the Project.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 STORAGE, GENERAL

The Contractor shall provide for the storage of construction materials and products for the Work of the Project in accordance with the following:

A. Store products, immediately upon delivery at a location approved by the Owner’s Authorized Representative (OAR), in accordance with manufacturer's instructions, with seals and labels intact. Protect such products until in final installed condition. Material shall not be stored in the ramp/operational terminal areas.

B. Deliver products too large to fit through openings to the Project site in advance of the time enclosing walls and roofs are erected. Set such products in place on raised cribs.

C. Arrange storage in a manner to provide access for maintenance of stored items and for inspection.

D. Inspect stored products frequently to ensure that the products are maintained in acceptable conditions.

E. Replace any products determined to be damaged upon delivery or damaged while in storage. A Contract Time extension will not be granted for re-ordering of the damaged products.

F. Provide access to the OAR for progress payment verification and approval purposes.

G. Arrange for ordering and storing approved long lead items.

H. Provide bonded off-site storage and protection when the Project site does not permit on-site storage or protection.

3.2 ENCLOSED STORAGE

The Contractor shall provide adequate enclosed product storage on the Project site meeting the following requirements:

A. Store products, subject to damage by the elements, in substantial weather-tight enclosures.

B. Maintain temperature, humidity, and ventilation as required by the manufacturer's instructions.

C. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.
3.3 EXTERIOR STORAGE

The Contractor shall provide exterior storage on the Project site meeting the following requirements:

A. Provide substantial platforms, blocking, or skids, to support fabricated products above ground; slope to provide drainage. Protect products from rusting, disfigurement, soiling, staining and damage.

B. Cover products subject to deterioration from exposure to the elements with impervious sheet materials and provide adequate ventilation to avoid condensation.

C. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.

D. Provide positive surface drainage to prevent erosion and ponding of water.

E. Prevent mixing of refuse or chemically injurious materials or liquids.

F. Do not stockpile materials higher than 30 feet unless shown otherwise in the Plans or as directed by the OAR.

3.4 MAINTENANCE OF EQUIPMENT STORAGE

The Contractor shall protect and maintain mechanical and electrical equipment in storage throughout the Project including, but not limited to, the following:

A. Provide the supplier's service instructions on the exterior of the package.

B. Service equipment on a regular basis as recommended by the supplier. Maintain a log of maintenance services and submit the log as Record Data at the Final Completion of the Project.

C. Provide power to and energize space heaters for all equipment for which these devices are provided.

D. Provide temporary enclosures for all electrical equipment, including electrical systems on mechanical devices. Provide and maintain heat in the enclosures until equipment is energized.

PART 4 - MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART 1 - GENERAL

1.1 SUMMARY

This Section includes the following:

A. Mobilization of equipment, personnel, material, supplies, tools, and all other resources necessary prior to beginning the Work.

B. Establishment of temporary facilities and all other facilities necessary prior to beginning the Work.

C. When a staging area is required in the Plans, the Contractor shall abide by the Land Use Application provided in Section 01 71 14.01.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 PROJECT INITIATION

A. The Mobilization fee shall not exceed eight (8) percent of the total Contract Amount.

B. The Contractor shall complete all required coordination and forms, submit permits and insurance certificates prior to beginning any construction activity.

C. The Contractor may complete all required temporary facilities as outlined in the Division 01 Sections prior to other construction activities and complete the move-in process after the Land Use Application has been completed and approved.

D. The Contractor shall coordinate with the Owner's Authorized Representative (OAR) to establish the Project submittals procedures, Baseline Schedule and payment procedures.

3.2 FINAL CLEANUP

Complete clean up and submit all required final documentation prior to move-out.

PART 4 – MEASUREMENT AND PAYMENT

A. Measurement

Measurement of the item "Mobilization" will be by the "Lump Sum," as the Work progresses as specified in the Contract.

B. Payment

1. When one (1) percent of the Contract Amount has been earned by the Contractor, 50 percent of the Mobilization Pay Item or five (5) percent of the total Contract Amount, whichever is less, will be paid. Previous payments under this item will be deducted from this amount.

2. When five (5) percent of the Contract Amount has been earned, 75 percent of the Mobilization Pay Item, or ten (10) of the total Contract Amount, whichever is less, will be paid. Previous payments under this item will be deducted from this amount.

3. When ten (10) percent of the Contract Amount is earned, 90 percent of the Mobilization Pay Item or 15 percent of the total Contract Amount, whichever is
less, will be paid. Previous payments under this item will be deducted from this amount.

4. Upon completion of all Work under this Contract, payment for remainder of the Mobilization Pay Item will be paid.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY

This Section includes the requirements and limitations of cutting and patching as part of the Work.

1.2 DESCRIPTION OF REQUIREMENTS

A. Coordinate the patching of surfaces and finishes in areas where existing items are removed. Drilling the work to install fasteners and similar operations are excluded from the definition of cutting-and-patching.

B. Adhere to all safety precautions as outlined in Section 01 11 00, Summary of Work.

C. Refer to other sections of these specifications for specific cutting-and-patching requirements and limitations applicable to individual units of work.

1.3 SUBMITTALS

A. Submit a written request to Owner’s Authorized Representative (OAR) in advance of executing cutting or alteration, other than required by Contract Documents, which affects:
   1. Work of Owner or any separate contractor.
   2. Structural value or integrity of any element of Project.
   3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
   4. Efficiency, operational life, maintenance or safety of operational elements.
   5. Visual qualities of sight-exposed elements.

B. Request shall include:
   1. Identification of Project.
   2. Location and description of the affected Work.
   3. Necessity for cutting, alteration or excavation.
   4. Effect on any work of the Owner or any separate contractor, or on structural or weatherproof integrity of Project.
   5. Description of proposed Work:
      a. Scope of cutting, patching, alteration, or excavation.
      b. Trades who will execute work.
      c. Products proposed to be used.
      d. Extent of refinishing to be done.
      e. Cost proposal when applicable.
   6. Alternatives to cutting and patching.
   7. Written confirmation from manufacturer or installer of existing affected work that cutting and patching work will not void warranty.
C. Submit a request for Substitution should conditions of Work or schedule indicate change of products from original installation.

D. Submit written notice to the OAR designating date and time the work will be uncovered or altered.

1.4 COORDINATION
Coordinate the cutting and patching work with manufacturer and installer of warranted materials, products or systems to avoid voiding warranty where warranties are in force for the existing work.

1.5 QUALITY ASSURANCE
Requirements for Structural Work: Do not cut-and-patch structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.

PART 2 – PRODUCTS

2.1 MATERIALS
A. Provide materials for cutting-and-patching which will result in equal-or-better work than the work being cut-and- patched, in terms of performance characteristics and including visual effect where applicable. Comply with the requirements of the Contract Documents, and use materials comparable with the original materials and where recognized that satisfactory results can be produced thereby.

B. Submit request from the OAR for further direction should conditions of work or schedule indicates change of products that are not comparable with the original installation.

PART 3 – EXECUTION

3.1 EXAMINATION
A. Examine existing conditions of the Work, including elements subject to damage or to movement during cutting, patching, excavating, and backfilling.

B. Examine conditions affecting installation of products, or performance of work.

C. Report unsatisfactory or questionable conditions to OAR. Do not proceed with the Work until notified by the OAR.

3.2 INSTALLATION
A. Do not cut-and-patch structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio. Provide adequate temporary support for work to be cut, to prevent failure. Do not endanger other work.

B. Provide adequate protection of other work during cutting-and-patching, to prevent damage; and provide protection of the work from adverse weather exposure.

C. Maintain excavations free of water.

D. Conform to requirements for temporary barriers, enclosures, and controls described in Section 01 50 00.

3.3 DUST CONTROL
Provide positive methods of dust control and apply dust control materials to minimize raising dust from cutting and patching operations.
3.4 PERFORMANCE

A. Patch with seams which are durable. Complete with specified tolerances for the work.

B. Employ skilled tradesmen to perform cutting-and-patching.

C. Cut work by methods which will not cause to damage to materials to be retained and work adjoining the cut area.
   1. Flame cutting of the reinforcing bars is discouraged but permitted if in compliance with the requirements of the American Welding Society (AWS) D.1.1 Structural Welding Code – Steel and D.1.4 Structural Welding Code – Reinforcing Steel by an experienced welder and as per directions by the OAR. Flame cutting in the Air Operations Area (AOA) is not permitted.
   2. Where physical cutting action is required, cut work with sawing and grinding tools, not with hammering and chopping tools. Core drill openings through the concrete.

D. Fit work to pipes, sleeves, ducts, conduit and other penetrations through surfaces as called for elsewhere in the Contract Documents. Allowing for movement where movement is required, fill space around pipe or insert with material with physical characteristics equivalent to fire-resistant requirement of penetrated surfaces where fire-rated separations are penetrated.

E. Restore exposed finishes of patched areas and, where necessary, extend finish restoration onto retained work adjoining, in a manner, which will minimize evidence of patching.

F. Refinish entire affected surface as necessary to provide even finish similar to adjacent finishes.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY

This Section covers the requirements of cleaning the Work area and disposal of waste materials, debris, and rubbish during construction of the Project.

PART 2 – PRODUCTS

2.1 EQUIPMENT

The Contractor shall provide covered containers for waste materials, debris, and rubbish.

PART 3 – EXECUTION

3.1 CLEANING

The Contractor shall perform the following and as may be directed by the Owner’s Authorized Representative (OAR):

A. Remove waste materials, debris, and rubbish at least daily. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, culverts, and other closed or remote spaces prior to closing the space.

C. Clean interior areas prior to application of finishes, and maintain in a clean condition to eliminate dust.

D. Avoid causing flying debris in the ramp areas or near the airfield.

E. Keep the Air Operations Area (AOA) and all haul routes free of any debris that may be generated from a construction activity.

3.2 DISPOSAL

Collect and remove waste materials, debris, and rubbish from the Project site in accordance with Section 01 74 19.

3.3 OWNER’S RIGHT TO CLEAN UP

The Owner may provide progress cleaning if the Contractor fails to comply with this Section. In such case, the Owner will deduct the cost of this cleanup effort from the Contract Amount.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART 1 - GENERAL

1.1 SUMMARY
This Section describes the procedures and practices to minimize or eliminate discharge of concrete waste to storm drain systems or water courses throughout the performance of the Work.

1.2 SUBMITTALS
A. The Contractor shall submit the following to the Owner's Authorized Representative (OAR):
   1. A detail for a Contractor concrete slurry containment system; and
   2. A detail for a Contractor concrete washout area.

1.3 REFERENCES
A. The following is a list of policies and regulations which may be referenced in this Section:

PART 2 – PRODUCTS
Not Used.

PART 3 – EXECUTION

3.1 CONCRETE SLURRY
A. General
   1. The Contractor shall contain all concrete slurry to prevent discharge to a storm drain or surface water.
   2. The concrete slurry shall be continuously vacuumed during sawcutting and slurry and cuttings shall not be allowed to remain on the pavement to dry.
   3. The Contractor shall remove slurry residue by abrasion (e.g. scraping or bristle broom) until no further residue may be loosened and only a stain remains.
   4. When the Contractor is performing a sawcut operation near a storm drain, the Contractor shall place sand bags or a similar Best Management Practice (BMP) to block the drain during such activities.
   5. The Contractor shall remove the BMP immediately upon completion of the sawcut operation.

B. Slurry Container
   1. The Contractor shall place the vacuumed slurry into a water-tight slurry waste container and place a sign on the waste container stating “Concrete Slurry Waste Only” in English and Spanish.
   2. The slurry shall be allowed to dry prior to disposal and the hardened slurry waste shall be disposed in accordance with Section 01 74 19.
C. Slurry Containment

1. If a large amount of concrete slurry waste is anticipated, the Contractor may construct an on-site slurry containment facility.

2. The Contractor shall submit a construction detail or design plan to the OAR to obtain the approval of the Airport Environmental Affairs Department (EAD) prior to construction.

3. The onsite containment may be accomplished through an excavation or constructing a berm to contain the slurry at the surface. Any containment area shall be lined with plastic a minimum of 10 millimeters thick.

4. The containment shall not be located within 50 feet of an inlet, swale, drainage way, channel, and other continuous or interim water body.

5. The Contractor shall place a sign adjacent to the containment stating “Concrete Slurry Waste Only” in English and Spanish.

6. The concrete slurry shall be removed by the Contractor when containment is 50 percent full, and always maintain a minimum of one (1) foot freeboard.

7. Allow slurry to dry before disposal.
   a. If it is not feasible to wait for slurry water to evaporate prior to disposal, the Contractor may coordinate with the EAD for additional options.
   b. Any water discharged from a slurry containment area shall not exceed a pH of 8.0.

8. The Contractor shall remove all materials used to construct the concrete slurry containment area from the work site and dispose of waste in accordance with Section 01 74 19.

3.2 CONCRETE TRUCK WASHOUT

A. General

1. The Contractor shall contain all concrete truck washout water to prevent discharge to a storm drain or surface water.

2. The concrete truck washout containers shall provide sufficient volume to completely contain all liquid and concrete waste generated during washout procedures and a minimum one (1) foot freeboard shall be maintained at all times.

3. The Contractor shall use a vacuum truck to remove excess water and prevent overflowing of the washout containers.

4. Any concrete truck washout shall be located a minimum of 50 feet away from an inlet, swale, drainage way, channel, and other continuous or intermittent water body.

5. The Contractor shall obtain written approval from the OAR and the Airport Operations Department prior to placing a concrete truck washout on the AOA.

B. Owner Provided Concrete Washout Bin

1. The Owner may supply a concrete washout bin for the Project under a separate contract. The EAD will determine if the Project meets the
requirements to receive a concrete washout bin based on the size of the Project, amount of concrete to be poured, and location of the Project.

2. All requests for service for the Concrete washout bin shall be coordinated with the EAD, through the OAR, a minimum of 48 hours or two (2) Working Days in advance of the need.

3. The EAD will coordinate bin delivery, the removal of excess water, relocating a bin, replacing a bin, and removing a bin through the OAR.

4. The only materials allowed to be placed in the concrete washout bin are concrete waste and water from concrete mixer trucks, pump trucks, mixers, chutes, tools, and wheelbarrows. Concrete slurry waste from sawcutting, grinding, and grooving is not allowed to be placed in the bin.

5. The concrete washout bin shall not be moved or shifted in any way. Damage caused to the concrete washout bin shall be paid by the Contractor to the owner of the bin directly. Any damages not paid by the Contractor shall be deducted from the Contract Amount.

C. Contractor Provided Concrete Washout Facility

1. When the Owner will not supply a concrete washout bin, or that the bin provided is not suitable for the Contractor’s operation, the Contractor may construct a concrete washout facility.

2. The Contractor shall submit a construction detail or design plan to the OAR for EAD approval prior to construction.

3. The washout facility shall include a containment area accomplished through an excavation or constructing a berm to contain the material at the surface. The containment area shall be lined with plastic a minimum of 10 millimeters thick.

4. The containment area shall be designed to provide six (6) cubic feet of storage for every ten (10) cubic yards of concrete poured.

5. The Contractor shall allow concrete washout to harden prior to disposal and the hardened waste shall be disposed in accordance with Section 01 74 19.
   a) If it is not feasible to wait for concrete waste water to evaporate prior to material disposal, the Contractor shall coordinate through the OAR with the EAD for additional options of disposal.
   b) Any water discharged from the containment area shall not exceed a pH of 8.0.

6. The Contractor shall break down any residual materials and dispose such materials in accordance with Section 01 74 19.

7. The Contractor shall remove the containment area within seven (7) Calendar Days of completing the concrete pours, or as soon as the concrete has hardened in the containment area to avoid collecting stormwater or as otherwise directed by the OAR.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.
PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall be responsible for waste handling, transport, and disposal activities. All waste handling activities including, but not limited to, packaging, labeling, marking, storage, and disposal will be conducted in accordance with applicable regulations and the Environmental Affairs Department (EAD) procedures.

B. The Owner and its contractors are expected to minimize the generation of construction waste, regulated waste and encourage recycling/reuse/salvaging whenever feasible.

C. Utilize the minimum screening and testing criteria described by this Section for constituents of concern where contaminants are known, anticipated or encountered.

D. Report weights of materials recycled and materials not recycled or reused throughout the project.

E. Remove all Contractor-generated Waste from the Airport property and dispose of properly.

F. Costs associated with performing analytical sampling, screening, containerizing, storing, transportation and disposal of impacted soil, solid waste, hazardous wastes, special wastes, regulated wastes, universal wastes, in solid or liquid form, and materials that are recyclable, reusable, or salvageable is the responsibility of the Contractor, unless otherwise stated in the Contract.

1.2 DEFINITIONS

A. Class 1 Waste: Any nonhazardous industrial solid waste or mixture of industrial solid wastes that, because of its concentration, or physical or chemical characteristics, is toxic, corrosive, flammable, a strong sensitizer or irritant; a generator of sudden pressure by decomposition, heat, or other means; or may pose a substantial present or potential danger to human health or the environment when improperly managed, processed, stored, transported, or disposed of or otherwise managed, as further defined in Chapter 30 of Texas Administrative Code (TAC) §335.505.

B. Class 2 Waste: Any individual industrial solid waste or combination of industrial solid wastes that cannot be described as Hazardous, Class 1, or Class 3 as defined in Chapter 30 TAC §335.506.

C. Class 3 Waste: Inert and essentially insoluble industrial solid waste, usually including but not limited to materials such as rock, brick, glass, dirt, and certain plastics and rubber that is not readily decomposable, as further defined in Chapter 30 TAC §335.507.

D. Generator: Entity that produces the waste.
   1. Existing Airport site/facility – The waste generated is to be managed as Owner generated wastes.
   2. All waste resulting from materials brought on-site by Contractor or waste resulting from Work (that is not Owner waste) is to be managed as Contractor generated waste.

E. Industrial Solid Waste: A solid waste resulting from or incidental to any process of industry or manufacturing, which may include a hazardous waste.
F. Regulated Waste: Any solid waste that requires special handling and disposal because of its quantity, concentration, physical or chemical characteristics.

G. Reuse: Making use of a material without altering its form. Materials can be reused on-site or reused on other projects off-site, as approved by the Owner.

H. Recycling: The process of sorting, cleaning, treating, and reconstituting materials for the purpose of using the material in the manufacture of a new product.

I. Representative Sample: A portion of a substance being tested that can be expected to exhibit the average properties of the whole. More guidance on sampling is available in the Texas Commission on Environmental Quality (TCEQ) document, “Industrial and Hazardous Waste Sampling and Shipping Procedures.”

J. Salvage: Recovery of materials for on-site reuse.

K. Solid Waste: Any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant or air pollution control facility, and other discarded material including solid, liquid, semisolid or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations.

1.3 ABBREVIATIONS

A. CESQG: Conditionally Exempt Small Quantity Generator as defined in 40 CFR 261.5.

B. NELAC: National Environmental Laboratory Accreditation Conference.

C. NVLAP: National Voluntary Laboratory Accreditation Program.

D. SMP: Soil Management Plan

E. WMP: Waste Management Plan

F. WMR: Waste Management Report

1.4 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

   a. Title 29 Part 1910, Occupational Safety and Health Standards
   b. Title 40 Part 260, Hazardous Waste Management System: General
   c. Title 40 Part 261, Identification and Listing of Hazardous Waste
   d. Title 40 Part 262, Standards Applicable to Generators of Hazardous Waste
   e. Title 40 Part 263, Standards Applicable to Transporters of Hazardous Waste
   f. Title 40 Part 266, Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
   g. Title 40 Part 268, Land Disposal Restrictions
   h. Title 40 Part 273, Standards for Universal Waste Management
   i. Title 40 Part 279, Standards for the Management of Used Oil

k. Title 49 Part 173, Shippers – General Requirements for Shipments and Packagings

l. Title 49 Part 177, Carriage by Public Highway

m. Title 49 Part 178, Specifications for Packagings

2. Texas Administrative Code:
   a. TAC Title 30 Chapter 335, Industrial Solid Waste and Municipal Hazardous Waste

3. Environmental Protection Agency Guidance:
   a. Characterization of Building-Related Construction and Demolition in the United States.
   b. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Compendium (SW-846)

4. Texas Commission on Environmental Quality Guidance:
   a. RG-022, Guidelines for the Classification and Coding of Industrial and Hazardous Wastes
   b. RG-086, Transporting Waste in Texas – A Guide to Regulations
   c. RG-234, Industrial and Hazardous Waste: Rules and Regulations for Small Quantity Generators
   d. RG-366/TRRP-13, Review and Reporting of COC Concentration Data under TRRP
   e. Industrial and Hazardous Waste Sampling and Shipping Procedures

5. Airport Publications:
   a. Green Building Standards (GBS)
   b. Contaminated Media Management Plan
   c. Integrated Waste Management & Pollution Prevention Plan

1.5 SUBMITTALS

A. A Waste Management Plan (WMP) shall be submitted to the Owner’s Authorized Representative (OAR) prior to receiving permit approval from the EAD.

B. A Waste Management Report (WMR) shall be submitted on the first of each month, and upon request by the OAR.

C. Waste profile documentation (process knowledge, waste profile form, applicable Material Safety Data Sheets (MSDS), and/or any analytical results) shall be submitted to the EAD, through the OAR, prior to submission to the landfill, for each hazardous or industrial waste stream.

D. Submit copies of manifests for all Owner generated regulated waste to the EAD, through the OAR, upon request and during Project close-out.
E. Submit copies of all construction demolition and landscaping waste or recycling documentation to the EAD, through the OAR, upon request.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 REGULATED WASTE MANAGEMENT - GENERAL

A. This section covers materials that are classified as regulated waste and may not be disposed of as construction, demolition, or land clearing waste.

B. The Contractor shall be responsible for the profiling, transportation, and disposal of all waste generated within the Project site or generated by the Contractor.

C. Each regulated waste stream generated will have its own waste profile.

1. The Contractor shall conduct testing and analysis of potentially regulated waste streams as soon as possible.

2. Laboratory analysis shall be conducted by NELAC or NVLAP (Asbestos Only) accredited lab. Ensure that individuals collecting samples have the appropriate training and regulatory credentials.

3. Containers shall be sampled separately, unless the waste is completely uniform. Waste is considered uniform if the waste is from one area.

D. The Contractor shall arrange for the transportation of waste to an approved disposal facility. The Contractor shall only use disposal or recycling facilities listed on the Pre-Approved Disposal/Landfill Facilities list. The list can be located at: https://www.dfwairport.com/sustainability/index.php

Landfills or Recycling facilities not listed, will need to be audited by the EAD before they will be added as an approved disposal location.

E. The Contractor shall ensure all waste leaves the Airport property with the proper shipping paperwork. When waste is ready for disposal it must be transported by a licensed Department of Transportation (DOT) transporter.

F. The Contractor shall dispose of all waste in a timely manner and prior to project closeout. Universal wastes must be disposed of within one (1) year from the date of generation. Hazardous wastes must be disposed of within six (6) months of the date of generation.

G. The following are a list of commonly encountered regulated wastes:

3. Asbestos;
4. Grease-trap waste;
5. Grit-trap waste;
6. Mercury containing equipment;
7. Non-reusable soil;
8. Paint and paint related waste;
9. Rechargeable Batteries
10. Water removed from fire suppression systems;
11. Fluorescent lamp ballasts that are not labeled as “No-PCB’s”;
12. Electronic lamp ballasts that contain batteries;
13. Used Lamps
14. Used Oil Filters

H. Unknown waste stream(s) (i.e unknown liquid and solid materials) not associated with the Project shall be communicated immediately to the EAD, through the OAR. EAD will assist in the proper characterization/profiling and disposal of unknown wastes. The OAR will determine whether the identified material is addressed in the Contract. Upon discovery, the Contractor shall properly contain the unknown waste in a safe manner. The Contractor shall not dispose or mix unknown wastes with other waste streams.

3.2 WASTE MANAGEMENT PLAN

A. Prior to obtaining a building permit, provide a WMP which includes the type of waste, the storage method, handling and transportation procedures, and the disposal location; and how the wastes will be managed in accordance with applicable Federal, State and local rules and regulations.

A template for the waste management plan can be located at: https://www.dfwairport.com/sustainability/index.php

B. Include in the WMP a description of how the plan will be conveyed to each new Subcontractor that enters the Project site and how containers will be identified.

C. Revise and resubmit when additional waste streams are identified, to make corrections, changes in disposal locations or as required by the OAR.

D. Approval of the WMP does not relieve the Contractor of responsibility for compliance with applicable environmental regulations.

3.3 REGULATED WASTE MANAGEMENT OF OWNER GENERATED WASTES

A. The Owner shall be considered the generator of all existing waste. Any waste resulting from materials brought on-site by the Contractor or waste resulting from work from an entity that is not the Owner, is to be managed as Contractor generated wastes. The Owner’s waste shall not be mixed with any other generator’s waste.

B. The EAD, through the OAR, will provide the Contractor with a regulated waste determination. The Contractor shall provide process knowledge form, MSDS, and/or lab results for the potentially regulated waste streams to the EAD, through the OAR.

The process knowledge form can be located at: https://www.dfwairport.com/sustainability/index.php

C. When sampling soil, the Contaminated Media Management Plan (CMMP) shall be followed.

D. The Contractor shall prepare the waste profile documents required by the landfill, including, at a minimum, the process knowledge, the waste profile form, applicable MSDS, and/or any analytical results. All waste profiles, and supporting
documentation, must be reviewed and signed by EAD staff prior to being submitted to the waste disposal facility for approval.

E. The Contractor shall ensure that shipping documents for Owner generated wastes are reviewed, and signed by an Owner's employee, or a representative designated by the Vice President, Environmental Affairs. Notification to the EAD, through the OAR, shall be provided, in advance, so that manifest signing arrangements can be coordinated. All shipping documents must be provided to the EAD, through the OAR.

F. Collect and prepare copies of all documentation including waste profiles, test results, manifests, and waste receipts that may be required for Project close-out.

3.4 REGULATED WASTE MANAGEMENT OF CONTRACTOR GENERATED WASTE

A. Any waste resulting from materials brought on-site by the Contractor or waste resulting from work from an entity that is not the Owner, shall be managed as Contractor generated wastes. Contractor generated wastes shall not be mixed with any generated waste from the Owner.

B. Waste disposal facilities may require the Contractor to complete a waste profile document that identifies the generator (Contractor), customer (Contractor), method of payment, characteristics of the waste (either from lab analysis or generator knowledge), and quantity of the waste. All waste profiles, and supporting documentation, must be provided to the Owner's staff, through the OAR, upon request.

C. Testing and analysis of potentially regulated waste streams shall be provided to the EAD, through the OAR. EAD can assist with sampling parameters upon request.

D. All documentation including waste profiles, test results, manifests, and waste receipts shall be made available to the EAD, through the OAR, upon request.

3.5 CONSTRUCTION, DEMOLITION, LAND CLEARING WASTE (CDL) & RECYCLING, REUSE SALVAGE MANAGEMENT

A. The Contractor shall submit a WMR to the EAD, through the OAR, on the first of each month and upon request. The WMR can be located at: https://www.dfwairport.com/sustainability/index.php

The waste management report includes the following information:

1. List of disposed, recycled, salvaged, or reused materials
2. The quantity of the materials
3. Copy of disposal or recycling receipts
4. Salvage documentation
5. Credit Receipts

B. Materials that are not characterized as regulated waste are considered CDL and may be disposed of as construction/municipal waste or recycled. The Contractor shall provide all necessary resources and labor to properly remove, contain, transport, and dispose of such waste or recyclable/reusable/salvageable material.

C. The Contractor shall utilize a qualified waste handling firm(s) to dispose of all construction waste on the project. This firm(s) shall transport non-recyclable, and/or recyclable materials to an Owner approved landfill or recycling location.
D. The Contractor shall be responsible for reporting weight, classification, any reimbursement rate of materials delivered and the supporting documentation to the OAR in the WMR.

E. The Contractor shall remove and properly dispose of CDL waste from the Project site on a regular basis. CDL waste shall not be allowed to accumulate on the Project site.

F. Recyclable, Reusable, Salvageable materials include, but are not limited to the following:
   1. Ferrous Metals (Steel)
   2. Non-Ferrous Metals (Copper and Stainless Steel)
   3. Tin
   4. Aluminum
   5. Asphalt
   6. Concrete
   7. Carpet
   8. Wood

3.6 WASTE MANAGEMENT PLAN IMPLEMENTATION
   A. Provide copies of the WMP to the job site foremen, and each Subcontractor.
   B. Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse and return methods to be used by all parties at the appropriate stages of the Project.
   C. Conduct waste management meetings during the weekly meeting to share and discuss waste management goals.
   D. Labeling and Containers:
      1. Label all containers in accordance with 30 TAC 335 Subchapter C and 40 CFR 262 & 264
      2. Package and label wastes to comply with Department of Transportation. DOT labeling requirements as specified in 49 CFR Parts 172, 173, 174, 177, 178, and 179 if transporting.
      3. Provide containers for CDL waste.
      4. Bins shall be protected during non-working hours from off-site contamination.
   E. Storage:
      1. Store wastes by classification and type, in accordance with 30 TAC 335. See “Guidelines for the Classification and Coding of Industrial and Hazardous Wastes” for more information.
      2. Place waste only in containers specifically marked and labeled for that waste.
      3. Provide containers compatible with the applicable waste stream.
      4. Waste containers shall be maintained in good condition and sealed closed when waste is not being added or removed.
      5. Do not store incompatible wastes near one another.
6. Space containers sufficiently apart to allow access in case of emergency.
7. Do not comingle regulated materials.
8. Ensure all hazardous, universal, or other regulated waste materials are segregated from CDL waste and recycled material.
9. Ensure recycled materials are clearly labeled with a list of acceptable materials. The list of acceptable materials must be the same as the materials recycled at the recycling processor facility.
10. Ensure recyclable materials contain no more than 10 percent non-recyclable material, by volume.
11. Retain Owner generated wastes on the Airport property in a secure location until waste characterization is complete and waste is ready for disposal.

F. Inspections:
1. The Contractor shall inspect waste storage areas weekly to ensure proper handling of wastes.
2. At a minimum, inspections shall observe the following:
   a. Presence of spilled material;
   b. Integrity of secondary containment structure;
   c. Maintenance of emergency pathways;
   d. Integrity of containers (evidence of leaking, bulging, or corroding);
   e. Closed and secured container lids or covers;
   f. Accurate and complete container labels;
   g. Segregation of containers by hazard class;
   h. Storage capacity of accumulation area;
   i. Segregation of regulated waste, CDL waste, and recycled materials.

PART 4 - MEASUREMENT AND PAYMENT
Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY
This Section covers the requirements for the Contractor to perform the final cleaning of the Project site.

1.2 PROJECT CONDITIONS
The Contractor shall conduct cleaning and waste disposal operations in full compliance with Federal, State, and local environmental and antipollution regulations, ordinances and laws.

A. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in stormwater or sanitary waste disposal systems.
B. Do not burn or bury debris, rubbish, or other waste material on the Project site.
C. Restore damaged areas to the conditions that existed prior to the start of construction as documented by the Contractor in a photographic record.

PART 2 – PRODUCTS

2.1 CLEANING MATERIALS
A. The Contractor shall use materials which will not create hazards to health or property, and which will not damage surfaces.
B. The Contractor shall use only materials and methods recommended by manufacturer of material being cleaned.

PART 3 – EXECUTION

3.1 FINAL CLEANING
A. General:
   1. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program using experienced workers or professional cleaners and complying with manufacturer’s cleaning instructions.
   2. Complete cleaning operations and conduct an examination of all Work areas with the Owner’s Authorized Representative (OAR) before requesting inspection for Substantial Completion.
B. Remove grease, petroleum or chemical spills, mastic, adhesives, dust, dirt, stains, fingerprints, labels, lubricants and other foreign materials from visible interior and exterior surfaces.
C. Remove temporary protection and labels.
D. Clean and polish transparent, reflective and glossy surfaces to a clear shine.
E. Vacuum clean carpet.
F. Clean resilient and hard-surface floors.
G. Clean sealed joints.
H. Clean permanent filters of ventilating equipment and replace disposable filters when units have been operated during construction. Clean ducts, blowers, and coils if units have been operated without filters during construction.
I. Clean light fixtures, lamps, globes, and reflectors. Replace burned out lamps and defective starters.

J. Maintain clean condition on the Project site until Final Acceptance.

K. Remove waste, foreign matter and debris from roofs, gutters, areaways and drainage systems. Flush roof drainage system with water until clear.

L. Remove waste, debris and surplus materials from the Project site. Clean grounds; remove stains, spills, and foreign substances from paved areas and sweep clean. Rake clean other exterior surfaces.

PART 4 - MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART 1 – GENERAL

This Section covers the requirements for the Contractor to protect the completed and/or installed Work on the Project.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

3.1 PROTECTION OF NEWLY INSTALLED WORK

The Contractor shall protect all installed work until Final Acceptance of the Project by the Owner using appropriate and effective means including, but not limited to, the following:

A. Restrict construction workers and traffic from completed and protected areas.

B. Prohibit all unnecessary traffic and storage from surfaces covered by roofing or waterproofing.

C. Provide adequate resilient protection and durable work platforms over all surfaces covered by roofing or waterproofing.

D. Provide clean, smooth plywood, or finished wood boards under all ladders, staging, or scaffolding placed on roofing and waterproofing.

E. Protect all finished surfaces including, but not limited to, door frames, doors, glass, floors, walls, ceilings, soffits, corners, fixtures, furnishings, equipment, and other finished surfaces and work.

1. Provide at least paper or plastic protection. In all locations of frequent traffic and all locations subject to moving objects whether wheeled or not, provide temporary plywood or fiber board walkways. Use only non-marking rubber tired carts, dollies, and wagons. Provide temporary plywood or boards under all materials stored over finished floors.

2. In addition to other acceptance criteria required by the Contract Documents, all finished surface shall be in acceptable condition at time of Final Acceptance by the Owner. Repair or replace all damaged materials as needed to achieve this requirement at no additional cost to the Owner.

F. Effectively protect all porous materials including, without limitation, gypsum board, insulation, ceiling tiles and panels, and other fibrous and water-susceptible materials from becoming wet or moisture damaged.

1. Remove and replace any portion of the Work which becomes water or moisture damaged.

2. Remove and replace any portion of the Work which shows evidence of biological growth, mold, and mildew.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY
This Section covers the use of a Punch List for the Project Closeout process on the Project.

1.2 DOCUMENTATION
A. All notifications, documentation, and transmittals between the Contractor and other Owner’s personnel as part of the Punch List process shall utilize the Skire Unifier software application, unless an alternate form of transmission is directed by the Owner for the Project.
B. If an alternate form of transmission is directed for the Project, all notifications, documentation, and transmittals shall utilize that form of transmission.

PART 2 - PRODUCTS
Not Used.

PART 3 - EXECUTION

3.1 SUBSTANTIAL COMPLETION
A. INSPECTION
1. Either party may initiate procedures for Substantial Completion of the Work in its entirety or a designated portion thereof. When the Contractor considers the Work (or a portion thereof that the Owner agrees to accept separately) is substantially complete, the Contractor shall notify the Construction Manager (CM) that the Project is considered ready for an inspection for Substantial Completion in accordance with Section 01 77 00 and shall prepare and submit to the CM a comprehensive list of items to be completed or corrected prior to Final Acceptance. Contractor shall proceed promptly to complete and correct items on the list. Failure to include an item on such list does not alter the responsibility of Contractor to complete all Work in accordance with the Contract Documents.
2. Upon receiving the notification and the list, the CM will schedule a walk-through inspection for the Project with the Contractor, the Inspector, and other Owner’s personnel which may have input on the Project or portion of the Project identified ready for inspection in the Contractor’s notification.
3. Upon completion of the walk-through inspection, the CM will document the results of the inspection and shall prepare a Punch List that includes all items which are determined to be incomplete or do not meet the requirements of the Contract Documents.
4. The CM will notify the Contractor of the Punch List. Contractor shall, before issuance of a notice of Substantial Completion, complete or correct those items on the Punch List.

B. CORRECTIVE ACTION
1. The Contractor shall review the Punch List and initiate repairs or other Corrective Action necessary to address each item on the Punch List to bring that item or portion of the Work into compliance with the Contract Documents.
2. The Contractor shall contact and coordinate with the CM to discuss or provide any unique Corrective Action for review and approval that will be required as part of the Work to resolve a Punch List item.

3. The Contractor shall complete each item identified on the Punch List, including those that had impacted the use and occupancy of I/S/E, unless the CM has pre-approved specific items on the Punch List as an exception for approval or for follow-up work.

4. The Contractor shall notify the CM that the Project is ready for a following walk-through inspection and shall prepare and submit to the Construction Manager an updated comprehensive list of items to be completed or corrected prior to Final Acceptance.

C. REINSPECTION

1. Upon notification by the Contractor that the Work is ready for a follow-up inspection, the CM will schedule the inspection for confirmation that the Punch List items are in conformance with the Contract Documents.

2. At the completion of the follow-up inspection, the Inspector or other Owner’s personnel will report the results to the CM, the CM will close each Punch List item or reject the item. The Contractor shall, before issuance of a notice of Substantial Completion, complete or correct those items on the Punch List.

3. When all items on the Punch List have been closed, the CM will close the Punch List.

4. The CM shall have the final decision as to whether or not the Contractor has achieved Substantial Completion. When the CM determines that the Work or designated portion thereof is substantially complete, which determination shall not be unreasonably withheld, the CM will notify the Contractor that Substantial Completion has been achieved, which notice shall establish the date of Substantial Completion.

5. Immediately prior to the issuance of a notice of Substantial Completion, the CM and the Contractor shall jointly inspect and document the condition of the Work, or designated portion thereof, to determine and record its condition, and the CM and the Contractor shall develop a final punch list which must be completed prior to Final Acceptance. The final punch list shall include all punch list items and other incomplete or missing items which CM elected in its discretion to waive for purposes of Substantial Completion. Any inspection and acceptance by Owner shall not, however, alter the Contractor’s responsibility to complete all Work in accordance with the Contract Documents, including items discovered by Owner after Substantial Completion.

3.2 FINAL ACCEPTANCE

A. INSPECTION

1. When the Contractor considers that the Work is finally complete, the Contractor shall notify the CM that the Project is ready for Final Inspection in accordance with Section 01 77 00 and shall provide the CM with all submittals required for Final Acceptance.
2. Upon receiving the notification, the CM will schedule the Final Inspection with the Contractor, the Inspector, and other Owner’s personnel which may have input on the Project.

3. Upon completion of the Final Inspection and all submittals required for Final Acceptance, the CM will update the Punch List noting all items are completed or identifying items incomplete or otherwise do not meet the requirements of the Contract Documents.

4. The CM will notify the Contractor of the status of the Punch List and whether it is complete or whether outstanding items exist.

B. CORRECTIVE ACTION

1. If any items on the Punch List are still outstanding, the Contractor shall complete those outstanding items as required until all items are completed.

2. The Contractor shall notify the CM that the Project is ready for a follow-up inspection.

C. REINSPECTION

1. Upon notification by the Contractor that the Work is ready for a follow-up inspection, the CM will schedule the follow-up inspection.

2. Upon completion of the follow-up inspection, the Inspector or other Owner’s personnel will report the results to the CM and the CM that will close each Punch List item or reject them.

3. When all items on the Punch List have been closed, the CM will close the Punch List.

4. The CM will notify the Contractor that the Punch List has been closed. The CM shall have the final decision as to whether the Contractor has achieved Final Completion, which approval shall not be unreasonably withheld. When the CM agrees that the Work is finally complete, the CM shall so notify the Contractor and set the date of Final Acceptance.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 This Section covers the requirements for closeout on all Projects.

1.2 COMMISSIONING

The Project may require a formal Commissioning process for one or more specific items of infrastructure, systems, and equipment (Systems). If Commissioning is included for Systems as part of the Project, refer to the Section 01 77 00.01 for additional information, procedures, and requirements for acceptance of such Systems by the Airport Energy, Transportation and Asset Management (ETAM) Department.

Section 01 91 00 includes more detailed requirements and explanation of the Commissioning Process.

1.3 The following items are included as part of the Project Closeout:

   A. Substantial Completion
   B. Final Inspection
   C. Closeout Submittals
   D. Evidence of payments and release of liens
   E. Final Adjustment of Accounts
   F. Final Payment Application
   G. Additional Adjustment
   H. Post-Construction Examination

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SUBSTANTIAL COMPLETION

A. Either party may initiate procedures for Substantial Completion of the Work in its entirety or a designated portion thereof. When the Contractor considers the Work to be substantially complete (or a portion thereof that the Owner agrees to accept separately), submit to the Construction Manager (CM) the following:

   1. Written certification that the Work and/or a designated portion thereof, is substantially complete.

   2. A list of items to be completed or corrected prior to Final Acceptance, recognized as incomplete, and reasons the Work is not complete. Contractor shall proceed promptly to complete and correct items on the list. Failure to include an item on such list does not alter the responsibility of Contractor to complete all Work in accordance with the Contract Documents.

B. Within seven (7) Calendar Days after receipt of such certificate and list, the CM will make examination to determine status of completion.

C. If the CM determines that the Work is not substantially complete:
1. The CM will promptly notify the Contractor in writing, providing the reasons for the such determination, and a Punch List including all the noted issues.

2. The Contractor shall remedy the noted deficiencies in the Work, and send a second written notice to the CM claiming Substantial Completion has been achieved on the Project and shall prepare and submit to the CM an updated comprehensive list of items to be completed or corrected prior to Final Acceptance.

3. The CM will then re-examine the status of the Work.

D. Upon the determination by the CM that the Work is substantially complete (the CM shall have the final decision as to whether or not the Contractor has achieved Substantial Completion, which approval shall not be unreasonably withheld), the CM will:
   1. Prepare a Certificate of Substantial Completion, accompanied by Contractor’s list of items that are recognized as outstanding and remain to be completed or corrected, as verified and amended by the CM.
   2. Submit a certificate to the Contractor for written acceptance of responsibilities assigned to the Contractor in the certificate.

As a condition to Substantial Completion, the Contractor shall (a) advise the CM of any pending insurance changeover requirements and (b) obtain and submit the Temporary Certificate of Occupancy, operating certificates, and similar releases enabling the Owner unrestricted use of the Project site.

Immediately prior to the issuance of a Certificate of Substantial Completion, the CM and the Contractor shall jointly inspect and document the condition of the Work, or designated portion thereof, to determine and record its condition, and the CM and the Contractor shall develop a final punch list which must be completed prior to Final Acceptance. The final punch list shall include all punch list items and other incomplete or missing items which CM elected in its discretion to waive for purposes of Substantial Completion. Any inspection and acceptance by Owner shall not, however, alter the Contractor’s responsibility to complete all Work in accordance with the Contract Documents, including items discovered by Owner after Substantial Completion.

E. After the Work or a designated portion thereof is substantially complete, the Contractor shall:
   1. Allow the Owner occupancy of Project site under any provisions stated in the Certificate of Substantial Completion.
   2. Complete the items listed for completion or correction within the certificate and/or final punch list provided by the CM.
   3. Perform final cleaning in accordance with Section 01 74 23.

3.2 FINAL INSPECTION

A. When the Contractor considers that the Work is finally complete, the Contractor shall provide the CM with all submittals required for Final Acceptance and shall submit written certification that:

D. Upon the determination by the CM that the Work is substantially complete (the CM shall have the final decision as to whether or not the Contractor has achieved Substantial Completion, which approval shall not be unreasonably withheld), the CM will:
   1. Prepare a Certificate of Substantial Completion, accompanied by Contractor’s list of items that are recognized as outstanding and remain to be completed or corrected, as verified and amended by the CM.
   2. Submit a certificate to the Contractor for written acceptance of responsibilities assigned to the Contractor in the certificate.

As a condition to Substantial Completion, the Contractor shall (a) advise the CM of any pending insurance changeover requirements and (b) obtain and submit the Temporary Certificate of Occupancy, operating certificates, and similar releases enabling the Owner unrestricted use of the Project site.

Immediately prior to the issuance of a Certificate of Substantial Completion, the CM and the Contractor shall jointly inspect and document the condition of the Work, or designated portion thereof, to determine and record its condition, and the CM and the Contractor shall develop a final punch list which must be completed prior to Final Acceptance. The final punch list shall include all punch list items and other incomplete or missing items which CM elected in its discretion to waive for purposes of Substantial Completion. Any inspection and acceptance by Owner shall not, however, alter the Contractor’s responsibility to complete all Work in accordance with the Contract Documents, including items discovered by Owner after Substantial Completion.

E. After the Work or a designated portion thereof is substantially complete, the Contractor shall:
   1. Allow the Owner occupancy of Project site under any provisions stated in the Certificate of Substantial Completion.
   2. Complete the items listed for completion or correction within the certificate and/or final punch list provided by the CM.
   3. Perform final cleaning in accordance with Section 01 74 23.
1. The Work has been examined for compliance and has been completed in accordance with Contract Documents.

2. Equipment and systems have been tested in presence of the CM and are operational.

3. Work is completed and ready for final examination.

B. The CM will re-examine the Project site to verify status of completion within seven (7) Calendar Days after receipt of such certification.

C. If the CM considers that any part of the Work is incomplete or defective:
   1. The CM will promptly notify the Contractor in writing, listing incomplete or defective work.
   2. The Contractor shall take immediate steps to remedy stated deficiencies, and send second written certification to the CM that the Work is complete.
   3. The CM will re-examine work.

D. When the CM determines that the Work is acceptable under Contract Documents (the CM shall have the final decision as to whether the Work is acceptable under the Contract Documents, which approval shall not be unreasonably withheld), he/she will notify the Contractor begin with the closeout submittals, who shall provide the CM with any remaining: (a) closeout submittals, (b) evidence of payments and release of liens, (c) final accounting, and (e) such other construction documents, certificates, warranties, instruments, and affidavits relating to the Work as the Owner may reasonably require.

3.3 CLOSEOUT SUBMITTALS

A. Evidence of compliance with requirements of governing authorities:
   2. Certificates of Inspection: Mechanical and Electrical systems as required by respective Sections.

B. Project Record Documents: Provide the record documents in accordance with Section 01 78 39.

C. Operations and Maintenance Data: Provide the data in accordance with Section 01 78 23.

D. Spare Parts and Maintenance Materials:
   1. Provide products, spare parts, and maintenance materials in quantities specified in each Section in addition to that required for completion of the Work.
   2. Coordinate delivery to the Project site with the CM and store items properly and obtain a receipt prior to Final Payment.

3.4 EVIDENCE OF PAYMENTS AND RELEASE OF LIENS

The Contractor shall deliver the following items to the CM:

A. Affidavit of Payment of Debts and Claims

B. Affidavit of Release of Liens
CLOSEOUT PROCEDURES
Section: 01 77 00

C. Affidavit of Release of Liens attachments:
   1. Consent of Surety to Final Payment
   2. Release or Waiver of Liens
   3. Separate releases of waivers of liens from subcontractors, suppliers and others with lien rights against property of Owner, together with list of those parties.

D. Submittals shall be duly executed before delivery to CM.

3.5 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit final statement of accounting to the CM.

B. Statement shall reflect adjustments to Contract Amount:
   1. Original Contract Sum
   2. Additions and deductions resulting from:
      a. Previous Change Orders
      b. Allowances
      c. Unit Prices
      d. Deductions for uncorrected Work
      e. Penalties and Bonuses
      f. Deductions for liquidated damages
      g. Other adjustments
   3. Total Contract Amount, as adjusted
   4. Previous payments
   5. Contract Amount remaining due

C. The CM will prepare a final Change Order, reflecting approved adjustments to Contract Amount, which were not previously incorporated previous Change Orders.

3.6 FINAL APPLICATION FOR PAYMENT

The Contractor shall submit final Payment Application in accordance with procedures and requirements stated in Conditions of the Contract. Final Payment shall not relieve the Contractor of any warranty obligations contained in the Contract Documents or at law, nor shall it act as a waiver of any claims relating to, but not limited to, any of the following, whether known or unknown at the time of Final Payment: (1) any liens or encumbrances, (2) any matter for which the Contractor or any subcontractor of any tier is liable or responsible at law, (3) any obligations or liability relating to the Contractor's warranties provided in the Contract Documents, (4) failure of the Work to comply with the Contract Documents, or (5) any breach or inaccuracy of any of the Contractor's representations or warranties under the Contract Documents, any Contractor Certificate or under any affidavit, certificate or other instrument or document provided to the Owner. In all cases, the Contractor, without prejudice to the terms of the Contract Documents shall be liable to the Owner for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Owner's rights under any warranty and guaranty and all applicable laws.
3.7 ADDITIONAL ADJUSTMENT

No adjustments to the Contract requested by Contractor will be allowed if asserted after execution of Final Payment on the Contract. Acceptance of final payment by the Contractor shall constitute a final and irrevocable release and waiver of claims and additional amounts, whether or not any such claims or potential claims arise in contract or in tort or were known or unknown at the time of the application for final payment.

3.8 POST-CONSTRUCTION EXAMINATION

A. Prior to expiration of one (1) year from date of Substantial Completion, the Owner's Authorized Representative (OAR), accompanied by other required Owner’s personnel, will make visual examination of Project site in the company of the Contractor to determine whether further correction of work is required in accordance with provisions of the Contract.

B. The OAR will promptly notify the Contractor, in writing, of any observed deficiencies.

C. The Contractor will contact the OAR to arrange time and establish a schedule for correction of deficiencies and verification by the OAR, and other required Owner's personnel, of the corrected discrepancies.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

– END OF SECTION –
PART 1 - GENERAL

1.1 This Section establishes the procedures required for acceptance of infrastructure, systems, and equipment (Systems) by the Airport Energy, Transportation and Asset Management (ETAM) Department when Commissioning such Systems is included as part of the Project.

1.2 The procedures herein shall be incorporated into the Project in coordination with Project Closeout requirements included in Section 01 77 00 and the Commissioning requirements included in Section 01 91 00.

PART 2 – PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 PRE-SUBSTANTIAL COMPLETION

A. Commissioning of Systems

1. Pre-Functional Checklists (PFCs) and Functional Performance Tests (FPTs) shall be conducted in accordance with the Commissioning Plan.

2. The Commissioning Issues Log shall be uploaded in Skier Unifier by the Commissioning Agent (CxAg).

B. Informal inspections of the Systems by the Airport Energy, Transportation and Asset Management (ETAM) Department requested by Contractor are conducted by ETAM as coordinated by the Owner’s Authorized Representative (OAR)

C. The Contractor requests OAR for formal inspection of completed Systems installation(s).

D. The OAR sends a request to the ETAM Commissioning Manager (CxM) to facilitate scheduling walkthrough inspection(s) by the OAR, Contractor, CxAg and ETAM representatives responsible for operating and/or maintaining the Systems. Note that the Systems may require a demonstration conducted by the Contractor as requested by the ETAM representative as part of the inspection.

E. The Punch List from the walkthrough inspection will be compiled by the CxM who will provide the Punch List to the CxAg to incorporate into the Commissioning Issues Log for non-commissionable items (items not in the Commissioning Plan). In addition, items impacting the use of the Systems will be noted.

F. The Contractor shall notify the OAR that Punch List items, including those that had impacted the use of Systems, have been resolved and the OAR notifies the CxM to facilitate scheduling a verification walkthrough by the responsible ETAM representatives as well as the CxAg. Note that the Systems may require a demonstration conducted by the Contractor as requested by the ETAM representative as part of the verification.

G. In coordination with the CxM, the CxAg notes the completion/resolution of Punch List items in Cx Issues Log for non-commissionable items.

H. The CxAg will complete the review of the following (any issues from this review will be included in the Commissioning Issues Log):

1. Operation and Maintenance (O&M) Manual(s)
2. As-Built CAD drawings
3. As-Built PDF file (.pdf)
4. As-Built 3D Model (when applicable)
5. Equipment lists

I. The CxAg will verify the completion of the following (any issues with this verification will be included in the Commissioning Issues Log):
1. Required training
2. Warranty certificates
3. Accessories delivered to ETAM

J. Upon notification to the ETAM Systems Performance Group (SPG) Manager by the OAR that all items on the Commissioning Issues Log (both commissionable and non-commissionable), including those that had impacted the use of the Systems, have been resolved as reported by the CxAg, the SPG Manager will send an email to the OAR declaring ETAM’s acceptance of the Systems upon achievement of Substantial Completion of the Project.

3.2 SUBSTANTIAL COMPLETION
B. Warranties become effective and managed by the ETAM SPG Warranty Administrator.
C. ETAM assumes ownership of installed Systems that ETAM will have operation and/or maintenance responsibility.
D. All remaining punch list items, which were determined not to impact the beneficial use of Systems, are resolved.

3.3 FINAL ACCEPTANCE
A. The Commissioning Report will be completed by the CxAg and approved by the Commissioning Authority (CxAu).
B. DCC issues a final Certificate of Occupancy.

PART 4 – MEASUREMENT AND PAYMENT
Not Used.

– END OF SECTION –
PART 1 – GENERAL

1.1 SUMMARY

This Section covers the requirements for the Operation and Maintenance (O&M) Manuals for all new operating equipment and systems furnished by the Contractor, and all materials and finishes as noted in specific Sections.

1.2 O&M, COMMISSIONING, TRAINING and WARRANTY SUBMITTALS

A. Delivery Method

The Contractor shall provide the Owner’s Authorized Representative (OAR) the manuals for the Project as follows:

B. Submit one (1) digital copy of the preliminary draft and three (3) hardbound copies and one (1) digital copy of the final complete manual as approved by the Owner.

C. Each electronic submission shall utilize the Skier Unifier software application, or as otherwise directed by the OAR, with a notification that an electronic submittal has been uploaded and is ready for review and comment.

1. If any content will not upload into the Skier Unifier software application, deliver electronic material to the OAR in the form of a DVD in digital PDF format, for review and comment.

2. The OAR will review the draft and return submittal comments electronically through the Unifier software application.

3. Upon successful completion of all O&M or Warranty Manual edits, the final version of the manual(s) will be uploaded into the Unifier software application, in the proper destination folder. In addition, two (2) hardbound copies of the final O&M Manual(s) shall be submitted to the OAR in complete form and delivered to the OAR with a transmittal letter.

4. Delivery Quantity- The Contractor and all Subcontractors shall upload all approved Project Record documents into the appropriate folder in the Unifier software application, including, but not limited to, the O&M, Warranty, Project Record Drawings, and one (1) set of Training DVD’s. In addition, one (1) hardbound copy and three (3) DVD copies of all finalized and approved O&M and Warranty Manuals, Project Record Drawings, and two (2) Training DVDs shall be delivered to the OAR.

D. Provide final the O&M Manual(s) for all equipment placed into service and operated by the Owner prior to Substantial Completion.

E. Utilizing the Owner provided data collection spreadsheet(s), complete the ETAB 101-New Equipment/Asset Inventory Form, ETAB 102-New Equipment/Asset Preventive Maintenance Task & Schedule Form, and ETAB 104-Equipment Warranty Information Form, as determined by the OAR.

The ETAB Equipment Asset Information EAM Forms may be obtained from a link on the following web-page:


F. Produce and deliver a professional quality video DVD recording for each training/instruction session. Refer to Section 01 79 00 for additional information.
G. Format of Electronic Submittal – O&M and Warranty

The Table of Contents directory shall be hyper-linked to the corresponding O&M section, shop drawing, and warranty chapters for expedited access. All digital PDF material is to be formatted for optical character recognition (OCR). All tables shall match the hardbound manual(s) in labeling and wording. The tables shall include active links as well.

H. Format of Hardbound Submittal – O&M and Warranty


2. Binders: Commercial quality, 8-1/2 inch x 11 inch, 3 inch 3-ring binders with hardback, cleanable, clear plastic covers with pockets. Binder assembly shall not exceed 75 percent of the binder capacity. If multiple binders are required for a complete series, correlate O&M data into related consistent groupings.

3. Binder and DVD cover preparation: Identify each binder with typed or printed title “Operation and Maintenance Instructions”; or “Warranty” list title and location of Project; Contract and Permit numbers, identify subject matter of contents. Identify each Volume ‘X of Y’ where it is the Xth volume of Y total volumes in each O&M set for the Project.

   Identify each volume as being in ‘Set A of B’ where the volume is part of the A4h set of B total final O&M Manual sets provided for the Project. Spine: Insert filler Tab that contains the Contract Name, “Operation and Maintenance Instructions”, or “Warranty” title line, and the Contract and Permit Number. DVD labels are to be the adhesive type, professionally printed and contain same project information relative to the Project.

4. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

5. Provide tabbed flyleaf for each separate product and system, with typed description of product and major component parts of equipment.

6. Text: Manufacturer’s original printed data. No second generation print will be accepted.

7. Shop Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

1.3 QUALITY ASSURANCE

The Contractor shall prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.4 PROJECT RECORD DRAWINGS

Project Record Drawings: The Contractor shall prepare new drawings where the OAR determines that neither the latest Contract Drawings nor the shop drawings are suitable to show the actual installation.

A. Coordinate with the OAR for the proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction.

B. When completing newly prepared drawings, utilize the procedures specified for organizing, copying, binding and submittal of Permanent Record Drawings in Section 01 78 39. All drawings shall include the required Airport “project record” stamp and
professional seals, Contract and Permit numbers, and printed name and signature of the authorized contracted individual.

C. All final Project Record Drawings will be prepared from the finalized Project CAD files, and assembled in a digital .DWG and PDF format in accordance with Section 01 78 39. NO handwritten comments will be accepted on finalized Record Drawings in PDF format. All comments, lines, shapes, etc., will be incorporated into the CAD set prior to the assembly of the final PDF Record Drawings. Both CAD and PDF files are to be provided on a DVD and submitted to the OAR, with appropriate Project information on label.

1.5 TAB FOR MATERIALS AND FINISHES
The Contractor shall prepare and organize the materials and finishes information in accordance with the following:

A. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designation. Provide information for re-ordering custom manufactured products. Include colorized photos of material finishes.

B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.


D. Additional Requirements: Refer to the individual Specifications Sections, as applicable.

E. Provide a listing in Table of Contents for design data, with tabbed flysheet and space for insertion of data.

1.6 MANUAL FOR EQUIPMENT AND SYSTEMS
The Contractor shall prepare and organize the manual(s) for equipment and systems information in accordance with the following:

A. Each item of equipment and each system: Include description of unit or system, and component parts. Provide the function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

B. Panel board Circuit Directories: Provide electrical service characteristics, controls, and communications.

C. Include as-installed color-coded wiring diagrams.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for troubleshooting; disassembly, repair, re-assembly instructions; and alignment, adjusting, balancing, and checking instructions.
F. Provide servicing and lubrication schedule, and list of lubricants required.
G. Include the manufacturer's printed operation and maintenance instructions.
H. Include the sequence of operation by controls manufacturer.
I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
J. Provide “as-installed” control diagrams and/or shop drawings by the controls manufacturer.
K. Provide the Contractor's coordination drawings, with “as-installed” color-coded piping diagrams.
L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
M. Provide a list of original manufacturer's spare parts, and recommended quantities to be maintained in storage for a 12-month period for OAR review and approval. Spare parts list shall contain the following information:
   1. Parts Descriptions.
   2. Manufacturer's Part Number.
   3. Shelf Life.
   4. Recommended Quantity.
   5. Unit Price.
   6. Name and address of the part manufacturer.
   7. Name and address of a local supplier for the part.
N. As applicable, include test and balancing reports, manufacturer factory test reports and certifications, system commissioning and operation testing reports, system start-up reports, and system maintenance reports prior to turn over of the Project.
O. Additional Requirements: As specified in individual Sections.
P. Provide a listing in the Table of Contents for design data, with tabbed flysheet and space for insertion of data.

PART 2 – PRODUCTS
2.1 CONTENTS, EACH VOLUME
The Contractor shall organize the information in accordance with the following:
A. Table of Contents: Provide title of Project including the Contract number and permit number; names, addresses and telephone numbers of the OAR and the Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

F. Warranties: Bind/Insert a copy at the end of each applicable section.

PART 3 – EXECUTION

Not Used.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION –
PART 1 – GENERAL

1.1 SUMMARY

This Section includes the general administrative and procedural requirements for warranties and bonds required of the Contractor based on the Contract Documents, including manufacturer's standard warranties on products and special warranties.

The Contractor shall perform the following:
A. Compile all the specified warranties and bonds.
B. Compile the specified service and maintenance contracts.
C. Co-execute submittals when so specified.
D. Review submittals to verify compliance with Contract Documents.
E. Submit to Owner's Authorized Representative (OAR) for review.

1.2 DEFINITIONS

A. Standard Product Warranties: Reprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
B. Special Warranties: Written warranties required by the Contract Documents, either to extend time limits provided by standard product warranties or to provide greater rights for the Owner.
C. Emergency Repairs: The Owner reserves the right to make emergency repairs as required to keep systems, equipment, or materials in operation or to prevent damage to persons or property without voiding Contractor's warranty or bond, or relieving the Contractor of its responsibilities during the Contract, warranty, or bond periods.

1.3 WARRANTY REQUIREMENTS

A. Related damages and losses: When correcting warranted Work that has failed, the Contractor shall remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
B. Reinstatement of warranty: When Work covered by a warranty by written endorsement., the reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation but not less than 50 percent of the original warranty period of time.
C. Replacement cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition as determined by the OAR and complying with requirements of Contract Documents.

Cost of replacing or rebuilding defective Work during the warranty period, regardless of whether the Owner has benefited from use of the Work, is the Contractor's responsibility.
D. Upon contact from the Owner by electronic communications, requesting repair work covered by warranty, the Contractor shall provide on-site response by repair team no later than twenty-four (24) hours from time of initial contact.
1.4 SUBMITTAL REQUIREMENTS

A. Assemble the warranties, bonds, service contracts, and maintenance contracts, executed by each of the respective manufacturers, suppliers, and Subcontractors.

B. Place all documents for each product in a separate tabbed section in the warranty book. Provide a Table of Contents listing each section in the binder.

C. Provide complete information for each item at the front of each tabbed section summarizing the following detail for each warranty section:
   1. Product or work item name.
   2. The Contractor or vendor responsible for the warranty, with name of the authorized representative, mobile number, email address, business address and telephone number.
   3. Scope of the warranty.
   4. Date of the beginning of each warranty, bond or service and maintenance contract will be established by the date of Final Acceptance as defined by OAR.
   5. Duration of warranty, bond, or service maintenance contract.
   6. Provide proper procedure to follow in the event of a warranty failure and include descriptions of conditions of operation or maintenance which might affect validity of warranty or bond.
   7. The Contractor or vendor, name of responsible principal, address, and telephone number.

D. Provide two (2) original signed copies of each warranty requiring a signature or other authentication.

E. Provide a completed Excel spreadsheets with ETAM 104-Equipment Warranty Information Form in accordance with Section 01 78 23.

1.5 FORM OF SUBMITTALS

A. Format:
   1. Size 8-½ inches x 11 inches sheets punched for standard 3-ring binder.
   2. Fold larger sheets to fit into binders.
   3. Cover with DFW Brand: Identify each packet with typed or printed title "Bonds and Warranties".
   4. List:
      a. Title of Project.
      b. Contract Number
      c. Name of Contractor.

B. Binders: Commercial quality, white, 3-ring and no larger than three (3”) inch diameter rings, with durable and cleanable plastic covers as approved by the OAR.
1.6 TIME OF SUBMITTALS
   
   A. Submit draft warranties along to the OAR through the Skire Unifier software application and one (1) hard copy to the Commissioning Agent (CxAg) 90 Calendar Days prior to Substantial Completion. Provide signed warranties or a letter of intent indicating that the draft warranty shall be provided with the final warranty book at Substantial Completion.
   
   B. Submit the final warranties to the OAR at Substantial Completion.
      1. When a designated portion of the Work is completed and occupied or used by the Owner, submit properly executed warranties to the OAR within fifteen (15) Working Days of the turnover of that designated portion of the Work to the Owner.
      2. For items of work, where Final Acceptance is delayed materially beyond of Substantial Completion, provide an updated submittal within ten (10) Calendar Days after acceptance, listing date of acceptance as start of warranty period.

1.7 SUBMITTALS REQUIRED
   
   Submit all warranties, bonds, service contracts and maintenance contracts as specified in each respective Section.

PART 2 – PRODUCTS
   
   Not Used.

PART 3 – EXECUTION
   
   Not Used.

PART 4 – MEASUREMENT AND PAYMENT
   
   Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 CLOSEOUT SUBMITTALS

A. At Contract closeout, the Contractor shall deliver the Record Documents to the Owner’s Authorized Representative (OAR). These records will be combined with the files from the Program Management Computer System and Central Document Files to make a complete history of the design and construction of the Project.

B. Record Document Finish Manual: This manual is required for all items requiring submittal for color, texture or finish selection. The finish manual shall be of “book” style with pages suited for mounting material samples.

C. Accompany submittal with transmittal letter in duplicate, containing:
   1. Date.
   2. Project title and number.
   3. Contractor’s name and address.
   4. Title and number of each record document.
   5. Signature of Contractor or the Contractor’s Authorized Representative (CAR).

PART 2 - PRODUCTS

2.1 MARKING DEVICES

Provide felt-tip marking pens for recording information in the color code designated by the OAR at the Pre-Construction Conference.

2.2 DRAFTING SERVICES

Retain competent drafting services, as necessary, for transfer of “mark up notations” from information recorded during construction.

PART 3 - EXECUTION

3.1 RECORD DOCUMENTS

The Contractor shall maintain at the Project site one marked-up record copy of:

A. Plans.
B. Specifications.
C. Addenda.
D. Change Orders and other modifications to the Contract.
E. OAR Written Instructions.
F. Approved shop drawings, product data and samples.
G. Field Test Records, to include Commissioning Plan and Test Results and Final Report.
H. Construction photographs.

3.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Store documents in Contractor’s field office apart from documents used for construction.
   1. Provide files and racks for storage of documents.
2. Provide secure storage space for storage of samples.

B. File documents and samples in accordance with the direction of the OAR.

C. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

D. Make documents and samples available at all times for inspection by OAR.

E. Incomplete or out of order documents and samples will be grounds for not approving application for payment.

3.3 RECORDING

A. Label each document "PROJECT RECORD", in neat large printed letters.

B. Record information concurrently with the Project construction progress. Do not conceal any work until required information is recorded.

C. Drawings: Legibly mark to record actual construction:
   1. Depths of various elements of foundation in relation to finish first floor datum.
   2. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
   4. Field changes of dimension and detail.
   5. Changes made by Field Order or by Change Order.
   6. Details not on the original Plans.
   7. Revisions to details shown on the Plans.
   8. Revisions to electrical circuitry.
   9. Actual equipment locations.
  10. Duct size and routing.
  11. References to related shop drawings and modifications.
  12. Note construction change directive numbers, alternate numbers, Change Order numbers and similar identification.

D. Not used.

E. Permanent Record Drawings (As-Built Drawings).
   1. The Contractor shall submit one (1) complete draft record set to the OAR for review in accordance with Special Provision 12.0. After the draft record approval, the Contractor shall submit a final record set of As-Built Drawings in electronic format as prescribed by the Airport CADD Standards Manual (CADD Manual) and this Section in AutoCAD.
   2. The Contractor shall submit a complete, organized set of AutoCAD .DWG files including individual sheet files, border files, base files, reference files, and any other type of file used to create each of the final .pdf sheet files. The files shall be organized in the standard organized folder structure that was used to create the .pdf sheet file from the individual sheet file. Each sheet file shall be saved.
with the border file and all base or reference files attached and functioning upon opening the individual sheet file.

3. Refer to Special Provision 12.0 for additional requirements including the Contractor's endorsement of each sheet for the final submission of the Permanent Record Drawings.

4. The Contractor shall submit one (1) copy of all Permanent Record Drawings files to the OAR on DVDs.

5. Converted As-Built Drawings require the appropriate certifications, endorsements, professional seals, and signatures.

6. Sheets shall be provided in “½ size” sheets – (equivalent to 17” x 22”).

7. Drawings may be bond copy affixed with appropriate certifications, endorsements, professional seals and signatures.

8. The As-Built set shall be arranged according to the Contract Plans sheet numbering and Specification numbering system used in the Contract Documents, including supplemental agreement and delivery order numbers. The Contractor shall provide an index and cross-referenced listing of each drawing sheet in the As-Built set.

F. Specifications and addenda: Legibly mark each section to record:

1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.

2. Changes incorporated into the Contract by Field Order or by Change Order or Request for Information (RFI).

3.4 BURDEN OF ACCURACY

Reference General Provisions for requirements.

3.5 RECORDING

A. Post changes and modifications to the Contract Documents as they occur. The OAR will periodically review record documents to assure compliance.

B. The Contractor shall bring the current set of As-Built Drawings to the first weekly meeting of the month for the OAR review.

PART 4 - MEASUREMENT AND PAYMENT

Not Used.

– END OF SECTION –
PART 1 – GENERAL

1.1 SUMMARY
This Section includes administrative and procedural requirements required of the Contractor for stocking of extra materials for the Project.

1.2 PRODUCTS REQUIRED
A. Provide the quantities of extra materials to the Owner specified in the individual Sections in addition to the quantities required for completion of the Work.
B. Provide products to be identical to those installed in Work. Include all the quantities required for the Project in the original purchase from the supplier or manufacturer to avoid variations in manufacture.
C. Provide a complete list, including Section or Plans references, of all extra materials to be provided under this Contract within 90 Calendar Days of the Notice of Proceed (NTP). Submit list to the Owner’s Authorized Representative (OAR) in both hardcopy and an electronic file in Microsoft Excel.

1.3 STORAGE AND MAINTENANCE
A. Temporarily store extra materials with products to be installed in the Work, in accordance with Section 01 66 00 or in other location acceptable to OAR.
B. When adequate secure storage facilities are available at the Project site capable of maintaining conditions required for storage of materials to the installed in the Work, the extra materials may be stored in available space.
C. Maintain extra materials in the manufacturer's unopened original containers with labels intact and legible, until delivery to the OAR.

1.4 DELIVERY
A. Coordinate final delivery of extra materials with the OAR prior to Substantial Completion.
B. Deliver, unload, store, and account for specified quantities of extra materials in presence of the OAR.
C. The OAR will indicate final placement in building of extra materials.
D. Obtain written acceptance from the OAR of receipt of specified quantities of extra materials.
E. For portions of Work accepted and occupied by Owner prior to Substantial Completion, the Contractor shall deliver proportional quantity of spare parts and maintenance materials if requested by the OAR. Record quantities delivered with the OAR.

PART 2 – PRODUCTS
Not Used.

PART 3 – EXECUTION
Not Used.
PART 4 – MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1 SUMMARY

This Section includes the demonstration and training requirements required of the Contractor on the Project.

A. The Contractor shall instruct and demonstrate the operation of each selected system to the Owner’s Authorized Representative (OAR) and other Owner’s maintenance and operations personnel.

B. Amount of time to be devoted to the instructional sessions shall be reasonable and consistent with size and complexity of equipment as determined by the OAR.

1.2 SUBMITTALS

A. The Contractor shall submit a proposed outline and syllabus for each instruction session to the OAR for approval, a maximum of twenty (20) Calendar Days and no less than ten (10) Calendar Days before scheduled date of instruction. Indicate the list of topics to be covered and identify training and visual aids, which will be used.

B. The Contractor shall produce a professional quality video recording on a properly labeled DVD in MP4 format for each instruction session. The recordings shall be produced by experienced videographers. One (1) original draft copy of each video shall be submitted to the OAR for approval. Any recordings of unacceptable quality shall be recreated at Contractor’s sole expense.

C. Submit complete record of instructions as part of Operations and Maintenance (O&M) Data given to Owner. For each instructional period, supply following data:

1. Date of Training
2. Date of Submittal
3. System or equipment involved
4. Names of instructors and affiliation
5. All participants present at the training.

D. Upon approval of the OAR, the Contractor shall upload one (1) copy of each training video into the Skier Unifier software application into the designated folder, unless otherwise directed by the OAR, and submit two (2) DVD copies of all training videos to the OAR.

1.3 QUALITY ASSURANCE

The Contractor shall arrange for services of qualified manufacturer’s representatives who are knowledgeable about the product to instruct the OAR and other Owner’s personnel on proper maintenance, operation and calibration of equipment.

PART 2 – PRODUCTS

2.1 INSTRUCTION PROGRAM

A. The Contractor shall furnish a minimum of five (5) draft O&M Manuals for the classroom instruction that shall be pertinent to the subject being covered and the approved syllabus.

B. The O&M Manual(s) shall constitute the basis of instruction. Review contents of the manual with the Owner’s personnel in full detail to explain all aspects of operations
and maintenance including, but not limited to, start-up, daily operation, control adjustment, trouble-shooting, servicing, and maintenance and shut-down of each item of equipment.

Prepare and insert additional data sheets as required in the O&M Manual(s) when it becomes apparent during instruction that it is needed as directed by the OAR.

PART 3 – EXECUTION

3.1 INSTRUCTION TO OWNER’S PERSONNEL

Prior to the date of Project Substantial Completion, the Contractor shall instruct the OAR and other Owner’s designated operating and maintenance personnel in operation, adjustment and maintenance of products, equipment, and systems at agreed schedule. For equipment requiring seasonal operation, perform training at the agreed schedule.

PART 4 - MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART – 1 GENERAL

1.1 SUMMARY
This Section includes general requirements and procedures for compliance with Airport Green Building Standards (GBS) prerequisites and credits needed for the Project to comply with Airport Sustainability Report.

1. Other GBS prerequisites and credits needed to obtain GBS certification are dependent on material selections and may not be specifically identified as GBS requirements. Compliance with requirements needed to obtain GBS prerequisites and credits may be used as one criterion to evaluate substitution requests.

2. Additional GBS prerequisites and credits needed to obtain the indicated GBS certification are dependent on the Architect/Engineer's design and other aspects of the Project that are not part of the Work of the Contract.

3. The GBS Project Checklist is included in Section 3 of the GBS.

1.2 DEFINITIONS
A. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles from the Project location. Manufacturing refers to the final assembly of components into the building product that is installed at the Project site.

B. Regionally Extracted, Harvested, or Recovered Materials: Materials that are extracted, harvested, or recovered and manufactured within a radius of 500 miles from the Project site.

C. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer.)
   1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
   2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.

1.3 SUBMITTALS
The Contractor shall provide the following:

A. Submit any additional GBS submittal requirements included in other Sections.

B. GBS submittals are in addition to other submittals. If the submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated the GBS and Airport Sustainability Report requirements.

C. Sustainability Action Plans: Provide preliminary submittals within fourteen (14) Calendar Days of the Notice to Proceed (NTP) indicating how the following requirements will be met:
2. MR Credit 1.4: Building Reuse - Maintain 50% of Interior Non-Structural Partitions

3. MR Credit 2.1 and 2.2: Construction Waste Management - Waste management plan complying with Section 01 74 19.

4. MR Credit 4.1 and 4.2: Recycled Content - List of proposed materials with recycled content.
   Indicate the cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.

5. MR Credit 5.1 and 5.2: Regional Materials - Provide a list of all proposed regionally manufactured materials and regionally extracted, harvested, or recovered materials.
   a. Identify each regionally manufactured material, its source, and cost.
   b. Identify each regionally extracted, harvested or recovered material, its source, and cost.

6. Indoor Environmental Quality Credit 3.1 and 3.2: Construction Indoor Air Quality (IAQ) Management Plan – During Construction and Before Occupancy - Provide a construction IAQ management plan.

D. Sustainable Progress Reports: The reports shall be concurrent with each Payment Application. Submit reports comparing actual construction and purchasing activities with sustainability action plans for the following:

1. MR Credit 1.1, 1.2, and 1.3: Building Reuse - Maintain Existing Walls, Floors, and Roof.

2. MR Credit 1.4: Building Reuse - Maintain 50% of Interior Non-Structural Partitions

3. MR Credit 2.1 and 2.2: Construction Waste Management - Waste reduction progress reports shall be included along with the Waste Management Report (WMR) described in Section 01 74 19.

4. MR Credit 4.1 and 4.2: Recycled Content.

5. MR Credit 5.1 and 5.2: Regional Materials - Regionally manufactured materials and regionally extracted, harvested, or recovered materials.

E. Sustainability Documentation Submittals:

1. Sustainable Sites (SS) Credit 8: Light Pollution Reduction – Submit the product data for interior and exterior lighting fixtures that stop direct-beam illumination from leaving the building site.

2. Water Efficiency (WE) Credit 3.1 and 3.2: Water Use Reduction – Submit the product data for plumbing fixtures indicating water consumption.


4. EA Credit 4.0: Enhanced Refrigerant Management – Submit the product data for new HVAC equipment indicating absence of hydrochlorofluorocarbon...
(HCFC) refrigerants, and for clean-agent fire-extinguishing systems indicating absence of HCFC and Halon.

5. **MR Credit 2.1 and 2.2: Construction Waste Management** - Comply with the requirements of Section 01 74 19.

6. **MR Credit 4.1 and 4.2: Recycled Content** – Submit the product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.

7. **MR Credit 5.1 and 5.2: Regional Materials** – Submit the product data indicating location of material manufacturer for regionally manufactured materials.
   a. Include statement indicating cost and distance from manufacturer to the Project for each regionally manufactured material.
   b. Include statement indicating cost and distance from point of extraction, harvest, or recovery to Project for each raw material used in regionally manufactured materials.

8. **EQ Credit 1.0: Outdoor Air Delivery Monitoring** – Submit the product data and shop drawings for carbon dioxide monitoring system.

9. **EQ Credit 3.1: Construction IAQ Management Plan**
   b. Submit the product data for temporary filtration media and filtration media used during occupancy.
   c. **Construction Documentation**: Six photographs at three (3) different occasions during construction along with a brief description of the Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA) approach employed, documenting implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.

10. **EQ Credit 3.2: Construction IAQ Management–Before Occupancy**
    a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
    b. Submit the product data for filtration media used during flush-out and during occupancy.
    c. Report from testing and inspecting agency indicating results of IAQ testing and documentation showing conformance with IAQ testing procedures and requirements.

11. **EQ Credit 4.1: Low-Emitting Materials-Adhesives and Sealants** – Submit the product data for adhesives and sealants used on the interior of the building indicating the volatile organic compound (VOC) content of each product used. Indicate the VOC content in gallons per liter calculated according to 40 CFR 59, Subpart D (EPA method 24).

12. **EQ Credit 4.2: Low-Emitting Materials–Paints and Coatings** – Submit the product data for paints and coatings used on the interior of the building.
indicating chemical composition and VOC content of each product used. Indicate the VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA method 24).

13. EQ Credit 4.3: Low-Emitting Materials–Flooring Systems – Submit the product data for carpet products indicating the VOC content of each product used.

14. EQ Credit 7.1: Thermal Comfort–Design – Submit the product data and shop drawings for sensors and control system used to monitor and control room temperature and humidity.

PART – 2 PRODUCTS

2.1 RECYCLED CONTENT OF MATERIALS

A. MR Credit 4.1: Recycled Content - Provide building materials with recycled content such that post-consumer recycled content constitutes a minimum of five percent of the cost of materials used for the Project or such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 10 percent of the cost of materials used for the Project.

B. MR Credits 4.1 and 4.2: Recycled Content - Provide building materials with recycled content such that post-consumer recycled content constitutes a minimum of 10 percent of the cost of materials used for the Project or such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 20 percent of the cost of materials used for the Project.

1. The cost of post-consumer recycled content of an item shall be determined by dividing the weight of post-consumer recycled content in the item by the total weight of the item and multiplying by the cost of the item.

2. The cost of post consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing the weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by the total weight of the item and multiplying by the cost of the item.

3. Do not include mechanical and electrical components in the calculation.


2.2 REGIONAL MATERIALS

A. MR Credit 5.1: Regional Materials - Provide minimum 20 percent of building materials (by cost) that are regionally manufactured materials.

B. MR Credit 5.2: Regional Materials – Provide regionally manufactured materials as required by subparagraph "MR Credit 5.1" above, provide at least 50 percent (by cost) that are regionally extracted, harvested, or recovered materials.

2.3 LOW-EMITTING MATERIALS

A. EQ Credit 4.1: Low-Emitting Materials-Adhesives and Sealants - For interior applications use adhesives and sealants that comply with the following limits for the VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24):

1. Wood Glues: 30 g/L.
2. Metal to Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Structural Glazing Adhesives: 100 g/L.
16. Wood Flooring Adhesive: 100 g/L.
17. Contact Adhesive: 250 g/L.
18. Plastic Cement Welding Compounds: 350 g/L.
19. ABS Welding Compounds: 400 g/L.
20. CPVC Welding Compounds: 490 g/L.
21. PVC Welding Compounds: 510 g/L.
22. Adhesive Primer for Plastic: 650 g/L.
23. Sealants: 250 g/L.
24. Sealant Primers for Nonporous Substrates: 250 g/L.
25. Sealant Primers for Porous Substrates: 775 g/L.

B. EQ Credit 4.2: Low Emitting Materials-Paints and Coatings - For interior applications use paints and coatings that comply with the following limits for the VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24) and the following chemical restrictions:

1. Flat Paints and Coatings: VOC not more than 50 g/L.
2. Non-Flat Paints and Coatings: VOC not more than 150 g/L.
3. Anti-Corrosive Coatings: VOC not more than 250 g/L.
4. Varnishes and Sanding Sealers: VOC not more than 350 g/L.
5. Stains: VOC not more than 250 g/L.
6. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
7. Restricted Components: Paints and coatings shall not contain any of the following:
   a. Acrolein.
   b. Acrylonitrile.
   c. Antimony.
   d. Benzene.
   e. Butyl benzyl phthalate.
   f. Cadmium.
   g. Di (2-ethylhexyl) phthalate.
   h. Di-n-butyl phthalate.
   i. Di-n-octyl phthalate.
   j. 1,2-dichlorobenzene.
   k. Diethyl phthalate.
   l. Dimethyl phthalate.
   m. Ethylbenzene.
   n. Formaldehyde.
   o. Hexavalent chromium.
   p. Isophorone.
   q. Lead.
   r. Mercury.
   s. Methyl ethyl ketone.
   t. Methyl isobutyl ketone.
   u. Methylene chloride.
   v. Naphthalene.
   w. Toluene (methylbenzene).
   x. 1,1,1-trichloroethane.
   y. Vinyl chloride.

PART – 3 EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT
   MR Credit 2.1 and 2.2: Construction Waste Management – Perform activities in compliance with Section 01 74 19.

3.2 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT
   A. EQ Credit 3.1: Construction IAQ management Plans-During Construction – Perform construction activities in compliance with SMACNA IAQ Guideline for Occupied Buildings under Construction.
1. If the Owner authorizes the use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 01 50 00, Temporary Facilities and Controls, install filter media having a Minimum Efficiency Reporting Value (MERV) of 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.

2. Replace all air filters immediately prior to occupancy. Replacement air filters shall have a MERV 13 according to ASHRAE 52.2.

B. EQ Credit 3.2: Construction IAQ Management-Before Occupancy

Engage an independent testing and inspecting agency to conduct a baseline indoor air quality testing program according to the EPA Protocol for Environmental Requirements, Baseline IAQ and Materials.

PART 4 – MEASUREMENT AND PAYMENT

Not Used.

- END OF SECTION -
PART 1 – GENERAL

1.1. SUMMARY
This Section includes the requirements for Commissioning the Project including:
A. Start up and testing of equipment and systems.
B. Identification and documentation of all infrastructure, systems, and equipment (Systems) issues and failures.
C. Corrective Actions and acceptance of corrected Systems.
D. Coordination of Commissioning requirements.

1.2 DESCRIPTION
A. Purpose
To obtain an approved Commissioning Plan and final Commissioning Report accepted by the Airport Commissioning Authority as required by Airport Board Policy (ABP).

B. Design and Construction Phase Commissioning Goal
Issuance of a Commissioning Plan to reflect the design intent of the final system configurations and operations necessary to obtain a permit for construction.

C. Post-Construction Phase Commissioning Goal
Issuance of an approved final Commissioning Report to reflect all Systems commissioned have been installed, operated, and tested to meet the construction specification requirements and have met the minimum operational and training requirements of the Owner as necessary for the Owner acceptance and issuance of a Certificate of Occupancy (CO).

D. Systems to be commissioned will be listed in detail in the Specifications listed below, and in PART 3 of this Section, when applicable with the Project’s Scope of Work:
1. Division 11 – Equipment
2. Division 13 – Special Construction
3. Division 14 – Conveying Equipment
4. Division 21 – Fire Suppression
5. Division 22 - Plumbing
6. Division 23 – Heating, Ventilation, and Air Conditioning (HVAC)
7. Division 25 – Integrated Automation
8. Division 26 – Electrical
9. Division 27 – Communications
10. Division 32 – Exterior Improvements
11. Division 33 – Utilities
12. Division 34 – Transportation
1.3 DEFINITIONS

A. Basis of Design: The Basis of Design (BOD) is a document that details the Architect/Engineer’s design plan to achieve the Owner’s Project Requirements (OPR). This document includes assumptions, existing conditions, and performance boundaries.

B. Commissioning: A systematic process of verifying and documenting that the performance and maintainability of Systems fulfill the operational and functional requirements of the Owner and the Owner’s representatives, users, and operators. Commissioning is intended to achieve the following specific objectives according to the Contract Documents.

1. Verify that all applicable Systems are installed according to the Contract, manufacturer’s recommendations, and to industry accepted minimum standards and that they receive adequate operational checkout by the Installing Subcontractor(s).
3. Verify that all Operations and Maintenance (O&M) documentation is complete.
4. Verify that the Owner’s operating personnel are adequately trained.

C. Commissioning Agent (CxAg): The person selected to chair the Commissioning Team and coordinates and oversees the development and execution of the Commissioning Plan. The CxAg will be a selected and employed by the Owner. The CxAg will be a licensed professional engineer in the State and experienced in the Commissioning of mechanical and electrical systems of the type and complexity installed in this Project. The CxAg will have experience in construction process, direct digital control systems, and test adjust and balance operations. The CxAg shall not be associated with or employed by the Contractor or any Subcontractor or equipment/system supplier connected with the Project.

D. Commissioning Coordinator: An authorized representative of the Owner, Contractor, Installing Subcontractor(s) or other members of the Commissioning Team who are designated in writing to the Commissioning Team, who attend Commissioning meetings and who act as the responsible central point of contact between their companies and the Commissioning Team.

E. Commissioning Authority (CxAu) or Designee (CxAuD): DFW Airport Board manager responsible for ensuring compliance with the DFW Airport Board Commissioning Policy and approving proponents for commissioning, the project commissioning plan, and the Final Commissioning Report.

F. Commissioning Plan: The plan prepared by the CxAg providing guidance and outlines the execution of the Commissioning process, verifying that the Systems perform at or above the expected level as specified in the Contract Documents. The Commissioning Plan is a detailed account of the Commissioning activities as they relate to the Project. The plan includes a listing of Commissioning Team members, phases of the Project, each team member’s Commissioning related responsibilities during each phase and the expected deliverables from each team member. Communication protocols between the members of the team and their respective companies are defined in the plan. As a living document, the plan will be continuously updated to reflect the evolving process as developed by the Commissioning Team. The Final Commissioning Plan is inclusive of the completed initial approved Commissioning Plan plus all approved and completed activities.
commissionable items associated with construction phase changes as provided for in the following:

1. Requests For Information
2. Design Change Notices
3. Approved Addenda or Alternatives
4. Approved final submittals, including control systems sequences of operation.

G. Commissioning Team: The group responsible for working together to implement the Commissioning process. The group can consist of all or part of the following members as dictated by the complexity and length of a Project:

1. Commissioning Authority (CxAu)
2. Senior Commissioning Manager (Sr. CxM)
3. Senior or Implementation Project Manager
4. Project Manager
5. Commissioning Manager (CxM)
6. Commissioning Agent (CxAg)
7. Architect/Engineer
8. Construction Manager at Risk (CMAR)
9. Contractor Commissioning Coordinator
10. Contractor
11. Controls Subcontractor (CC)
12. Electrical Subcontractor (EC)
13. Mechanical Subcontractor (MC)
14. Fire Protection Subcontractor (FPC)
15. Owner’s Authorized Representative (OAR)
16. Owner’s Authorized Facility Manager
17. Owner’s Authorized Central Utility Plant (CUP) Manager
18. Quality Assurance (QA) Inspectors
19. Design Code and Construction Department (DCC) Inspector
20. Design Code and Construction Department (DCC) Representative
21. Information Technology Systems (ITS) Representative
22. Department of Public Safety (DPS) Representative
23. Energy, Transportation and Asset Management (ETAM) Representative
24. Environmental Affairs Department (EAD) Representative
25. Testing, Adjusting and Balancing (TAB) Subcontractor
26. Other Installing Subcontractors or equipment suppliers.

G. Contractors Test Report: The Contractors’ tests are defined as any form of start-up, adjustment, or calibration performed on individual pieces of equipment as specified
within the Contract Documents. The CxAg will provide a test report form to be used by the Installing Subcontractor as a cover sheet to the actual test results, for the documentation of each specified contractors test. The Contractor is responsible to upload the digital documents to the Owner’s designated electronic project management system, the Skier Unifier software application, or as otherwise directed by the OAR for the Project.

H. Deficiency: An issue or observation that prohibits the successful passing of any step on the verification test procedure for any Systems that are specified in the Commissioning scope of the Project.

I. Issue: An observable item reported as a possible risk or concern to the Project.

J. Installing Subcontractor: The Subcontractor or supplier responsible for the actual installation of the System.

K. Owners Project Requirements (OPR): A written document detailing the functional requirements of the Project and the expectations of how it will be used and operated by the Owner. The document may include Project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information. This document may evolve as the Project progresses.

L. Pre-Functional Checklist (PFC)/System Readiness Checklist (SRC): A checklist created by the CxAg designed to demonstrate that the system is completely installed and ready for operational testing. At the end of installation, the Installing Subcontractor completes the operational checklist to certify that the work is complete and the system is ready for independent testing.

M. Functional Performance Test (FPT): A test that confirms each system will perform as specified functionally. The Installing Subcontractor shall perform each FPT. The CxAg will coordinate, witness, and document the FPT. During the FPT, the Installing Subcontractor shall sequence the system as outlined in the approved FPT procedure and provide the required test equipment and building automation system access as required.

1.4 COMMISSIONING AIRPORT BOARD POLICY and COMMISSIONING PLAN

A. Under Airport Board Policy ET.001 – Commissioning, it is the policy of the Board that all Board buildings and other appropriate facilities and Systems be commissioned. The policy provides the requirements for commissioning acceptance by the Airport’s Commissioning Authority and the Commissioning Authority Designees.

B. The Commissioning Plan provides guidance in the execution of the Commissioning process based on the Project Scope of Work.

C. Commissioning Process

The following provides a brief overview of typical Commissioning tasks during construction and the general order in which they should occur on the Project.

1. Commissioning during construction begins with a scoping meeting conducted by the CxAg where the Commissioning process is reviewed with the Commissioning Team members.

2. Additional meetings may be required throughout construction to plan, scope, coordinate, schedule future activities and resolve problems.

3. Equipment documentation including Architect/Engineer approved submittals are provided to the CxAg including detailed start-up procedures.
4. The CxAg works with the Commissioning Team in developing start-up documentation formats, including PFCs to be completed during the start-up process.

5. The checkout and performance verification proceeds from simple to complex, from component level to Systems and intersystem levels with PFCs being completed prior to functional testing.

6. The Installing Subcontractor(s), under his own direction, execute and document the PFCs and perform start-up and initial checkout. The Contractor documents that the PFCs and start-up were completed according to the approved plans. The Installing Subcontractor(s) will provide a minimum three (3) Working Days, notification to the CxAg, OAR, and other Owner's personnel of the date and time scheduled for performing start-up and initial checkout processes prior to the start up, so that they may witness start-up and the initial checkout.

7. The CxAg, in cooperation with the Installing Subcontractor(s), suppliers, and manufacturers develops specific equipment and system FPT procedures for all designated divisions and any other Systems identified as requiring Commissioning as part of the Project.

8. All other Divisions shall have the Contractor and the Installing Subcontractor(s), in cooperation with the suppliers and manufacturers; develop specific equipment and system FPT procedures to be submitted for Architect/Engineer approval and in accordance with the Project Specifications for use by the Commissioning Team for review, comment, and report form development. The FPT procedures are executed by the Installing Subcontractor(s), witnessed and documented by the CxAg after completion of the Installing Subcontractor(s) start-up procedures.

9. Items or issues associated with non-compliance in material, installation, setup, or sequence of operation are corrected at the Contractor’s expense and the system retested.

10. The Contractor reviews the O&M documentation for completeness and schedules and coordinates the Owner's personnel training. All O&M documentation must be submitted in accordance with Section 01 78 23 and approved prior to the start of training. Refer to Section 01 79 00 for additional requirements.

11. The Contractor reviews and coordinates the training provided by the Installing Subcontractor(s), suppliers, manufacturers, the CxAg documents and verifies that the training was conducted and met the minimum requirements of the Owner. Refer to Section 01 79 00 for demonstration and training requirements.

12. Deferred testing is conducted, as specified for standard testing.

13. Final Commissioning Plan shall be completed and documented prior to Substantial Completion.

14. A Commissioning summary log is required in the Commissioning Plan and report to identify all Systems designated to have warranties and their warranty duration. Refer to Section 01 78 33 for acceptance procedures for generic and final warranty manual submissions.

1.5 RESPONSIBILITIES

A. The Contractor shall:
1. Develop and provide a complete list of Systems to be commissioned and of Systems requiring Owner personnel training for inclusion into the Commissioning Plan.

2. Facilitate the coordination of the Commissioning work and ensure that Commissioning activities are being scheduled into the master schedule.

3. Include the cost of Commissioning in the Contract Amount.

4. Furnish a copy of all Contract Documents, Addenda, Requests for Information (RFI), Change Orders, and approved submittals and Shop Drawings related to commissioned Systems to the CxAg.

5. Ensure each purchase order or subcontract written, includes requirements for submittal data, O&M data, Commissioning tasks and training.

6. Assist with the development and documentation of Commissioning test procedures for all Systems with the Installing Subcontractor(s).

7. Ensure that all Installing Subcontractor(s) execute their Commissioning responsibilities according to the Commissioning Plan, Contract Documents, and schedule.

8. Designate a Commissioning Coordinator who shall attend Commissioning scoping meetings and other necessary meetings scheduled by the CxAg to facilitate the Commissioning process.

9. Coordinate the training of the Owner’s personnel, including reviewing and approving the training plans and coordinate the digital recordings of the Owner’s personnel training including clear audio recording of all questions and inquiries and their associated responses, in accordance with Section 01 79 00.

B. The Contractor shall ensure that all Installing Subcontractor(s):

1. Include the cost of Commissioning as a line item in the sub-contract price.

2. Provide submittal data, O&M data, Commissioning tasks and training according to Contract Documents in each purchase order or subcontract written.

3. Designate a Commissioning Coordinator who shall attend Commissioning scoping meetings and other meetings scheduled and required by the Commissioning Agent to facilitate the Commissioning process.

4. Provide normal cut sheets and shop drawing submittals of approved equipment as part of the submittals.

5. Provide documentation prior to normal O&M Manual(s) submittal to the Contractor and CxAg for development of start-up and FPT procedures.
   a. Provide the following to the Contractor and CxAg:
      1) Detailed manufacturer installation and start-up instruction.
      2) Operating, troubleshooting and maintenance procedures.
      3) Full details of any Owner-contracted tests.
      4) Full factory test reports.
      5) Full warranty information which clearly identifies all responsibilities of the Owner to keep the warranty in force.
6) Installation, start-up and checkout materials that are shipped with the equipment.

7) Actual field checkout sheet forms to be used by the factory or field technicians.
   a. Provide the proposed O&M Manual(s) format, organization, and content to the CxAg for review and comment. The manual shall follow the guidelines in accordance with Section 01 78 23.
   b. Provide additional documentation, deemed necessary by the CxAg, for the Commissioning process.

6. Prepare and provide a copy of the O&M Manual(s) and submittals of the commissioned Systems using normal submittal procedures through the Contractor to the CxAg for review and comment.

7. Assist in clarifying the operation and control of commissioned Systems in areas where the Project Specifications, control drawings, or equipment documentation are insufficient for writing detailed testing procedures. Coordinate efforts with the Architect/Engineer as required.

8. Coordinate with the CxAg and provide the specific FPT procedures to ensure feasibility, safety, equipment protection, and provide necessary written alarm limits to be used during the tests to the CxAg through the Contractor.

9. Develop a full start-up and initial checkout plan using the manufacturer’s start-up procedures and the PFCs for all commissioned Systems. Submit through the Contractor to the CxAg for review and comment prior to start-up.

10. Execute the SRCs for all commissioned Systems during the start-up and initial checkout process.

11. Perform and clearly document all completed start-up and system operational checkout procedures, providing a copy to the Contractor and the CxAg.

12. Address and resolve current Punch List items prior to beginning FPTs.

13. Provide skilled technicians to execute starting of equipment and to execute the FPT. Ensure that technicians are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem solving.

14. Perform FPTs for specified Systems. Assist the CxAg in interpreting the monitoring data, as necessary.

15. Correct all deficiencies which include differences between specified and observed performance as interpreted by the Contractor and/or CxAg and the Architect/Engineer and retest the equipment.

16. Prepare the O&M Manual(s) according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

17. Prepare redline and CAD (electronic) drawings for all final as-built drawings for Contractor-generated coordination drawings.

18. Provide training of the Owner’s operating personnel as required in the Commissioning Plan. Refer to Section 01 79 00 for demonstration and training requirements.
19. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty. Develop, execute and document Contractor maintenance plans for Systems placed into service prior to beneficial occupancy. Provide records and reports of all pre-turnover maintenance.

20. Provide the equipment for testing in accordance with the Project Specifications.

C. The Contractor shall ensure that equipment suppliers:

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep all applicable warranties in force.

2. Include all special tools, including software and instruments only available from the supplier and specific to a piece of equipment, required for testing equipment according to these Contract Documents in the base bid price provided to the Contractor. This bid price does not include stand-alone data logging equipment that may be used by the CxAg.

3. Provide information requested by the CxAg regarding Systems sequence of operation and testing procedures.

4. Review test procedures for Systems installed by factory representatives.

D. Architect/Engineer

1. Designate a Commissioning Coordinator who shall attend the Commissioning scoping meeting and other necessary meetings scheduled by the CxAg to facilitate the Commissioning process.

2. Provide the Basis of Design (BOD) documentation to the Contractor for inclusion in the O&M Manual(s).

3. Review SRCs for Systems to be commissioned.

4. Assist in clarifying the operation and control of commissioned Systems in areas where Project Specifications, control drawings, or equipment documentation are insufficient for writing detailed testing procedures.

5. Review O&M Manual(s) according to the Contract Documents.

6. Provide technical assistance for resolution of non-conformances or deficiencies as appropriate.

E. Commissioning Agent (CxAg)

The primary role of the CxAg is to coordinate the development and execution of the Commissioning Plan, and to observe and document performance of commissioned Systems, in particular, whether Systems are functioning in accordance with the documents design intent and in accordance with the Contract Documents. The CxAg is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxAg may assist with problem solving non-conformances or deficiencies, but ultimate responsibility for such corrections are the responsibility of the Contractor, Installing Subcontractor(s), manufacturer, and/or Architect/Engineer, as appropriate.

The CxAg will:

1. Coordinate the development of and maintains the Commissioning Plan.
2. Coordinate the Commissioning activities.

3. Coordinate the Commissioning work and coordinate with the Commissioning Team to ensure that Commissioning activities are being incorporated into the master schedule.

4. Assist with the revisions to the Commissioning.

5. Plan and conduct a Commissioning scope and coordination meetings.

6. Request and review information required to perform Commissioning tasks, including O&M materials, Contractor start-up and checkout procedures.

7. Prior to start-up operations, gather and review the current control sequences and interlocks and work with the Installing Subcontractor(s) and the Architect/Engineer until sufficient clarity has been obtained, in writing, to be able to assure detailed testing procedures are written.

8. Review the submittals of the Contractor and Installing Subcontractor(s) applicable to Systems being commissioned for compliance with Commissioning requirements, along with normal construction submittals.

9. Create, review, approve, and distribute preliminary pre-functional tests and PFCs.

10. Review and approve the start-up and initial checkout plan for Systems as developed by the Installing Subcontractor.

11. Perform site visits, to observe component and system installations. Attend selected planning and Project construction meetings to obtain information on construction progress. Review Project construction meeting minutes for revisions/substitutions relating to the Commissioning process. Assist in resolving any discrepancies.

12. Approve pre-functional tests and PFC completion by reviewing the PFC and by selected site observation and spot-checking.

13. Approve Systems startup by reviewing start-up reports and by selected site observation.

14. Analyze any FPT data as well as trend logs and monitoring data to verify performance.

15. Coordinate, witness, and approve manual FPTs performed by the Installing Subcontractor(s). Coordinate re-testing as necessary until satisfactory performance is achieved.

16. Review equipment warranties to ensure that the Owner’s responsibilities are clearly defined and provide a listing of warranties indicating equipment and duration of warranty.

17. Witness and document the training of the Owner’s operating personnel. Provide a sign in sheet for each session and conduct survey after each session.

18. Compile and maintain a Commissioning issues record log. Acceptance of the Commissioning process is dependent on the resolution of all Commissioning issue log items.
19. Review and approve the preparation of the Systems O&M Manual(s) in accordance with Section 01 78 23. Compile and provide listing of equipment for the O&M Manual(s).

20. Provide a final Commissioning Report including suggestions for improvement in the process.


22. Identify additional areas or Systems that should be included in the warranty manual information provided or in other areas under the Contract Documents.

23. Assist the Owner’s personnel in developing reports, documents, and requests for services to remedy outstanding problems.

1.6 SCHEDULING

The CxAg will work with the Commissioning Team to schedule the Commissioning activities. The CxAg will provide sufficient notice to the Commissioning Team for scheduling Commissioning activities. The Contractor shall integrate all Commissioning activities into the master schedule. All parties will address scheduling problems and provide the necessary notifications in a timely manner in order to expedite the Commissioning process.

1.7 QUALITY ASSURANCE

The Contractor and each Subcontractor involved with Systems to be commissioned on the Project will assign a Commissioning Coordinator with at least five (5) years’ experience with coordination of construction disciplines and verification testing of complete systems. This position is not a full time position unless the complexity of the job requires such a full time position. The Commissioning Coordinator(s) will be submitted for approval of the CxAg subject to satisfactory experience and performance. The Commissioning Coordinator(s) responsibilities shall include:

A. Coordination meetings.
B. Planning.
C. Scheduling.
D. Documentation.
E. Maintain close communication and coordination with the CxAg.
F. Development of testing procedures in coordination with the Installing Subcontractor(s).
G. Submitting the Contractor’s test report submittal to the CxAg.
H. SRCS submittal.
I. Perform system verification tests.
J. Corrective Actions rectification and documentation.
K. Specified training planning and coordination.

1.8 QUALITY CONTROL

A. Ensure that the Contractor and each Installing Subcontractor follows the established Contractor’s Quality Control (QC) program and procedures.
B. Ensure that the Contractor and each Installing Subcontractor corrects all deficiencies and incorporates the necessary adjustments to O&M Manual(s) and as-built drawings for applicable issues identified in any seasonal testing.

1.9 SUBMITTALS

A. The CxAg will provide the Contractor with specific requests for the type of submittal documentation required to facilitate the Commissioning work. These requests include the submission of electronic versions of all submittals, documents, manuals, etc. and will be integrated into the normal submittal process and protocol of the construction personnel and added to the Contractor’s submittal register. At a minimum, each request will include:

1. Manufacturer and model number.
2. Manufacturer’s printed installation and detailed start-up procedures.
3. Full sequences of operation.
4. O&M data.
5. Performance data.
6. Any performance test procedures.
7. Control drawings.
8. Details of Owner contracted tests.
9. List of installation materials that are shipped with the equipment.
10. Field checkout sheet forms to be used by the factory or field technicians.
11. Factory test results.

B. All documentation requested by the CxAg will be included in each Installing Subcontractor(s) contributions to the O&M Manual(s).

C. The CxAg will review and approve submittals related to the commissioned Systems for conformance to the Contract Documents as it relates to the Commissioning process, to the functional performance of the Systems, and to adequacy for developing test procedures. This review is intended primarily to aid in the development of FPT procedures and only secondarily to verify compliance with the Systems specifications.

D. The Contractor shall ensure that each Installing Subcontractor(s) designates a Commissioning Coordinator and provides information facilitating the incorporation and coding identification of Commissioning activities in the Construction Schedule within four (4) weeks of the Notice to Proceed (NTP).

E. The Contractor shall submit a detailed verification testing schedule to the CxAg at least four (4) weeks prior to start of testing.

F. The Contractor shall ensure that each Installing Subcontractor(s) submits test reports through the Contractor to the CxAg upon successful completion of each test.

G. The Contractor shall ensure that each Installing Subcontractor(s) submits information for the O&M Manual(s) (format, content, and organization) through the Contractor to the Architect/Engineer and the CxAg for review within at least ninety (90) Calendar Days prior to the start of scheduled verification testing.
H. The Contractor and each Installing Subcontractor(s) shall submit the O&M Manual(s) in accordance with the individual Specification Sections requiring an O&M Manual(s) and Section 01 78 23.

I. The supplier and Installing Subcontractor shall certify that the installed and operating Systems have been completed (with all deficiencies corrected) and that they are performing to in accordance with the Contract Documents including all tests and other requirements stipulated therein.

1.10 TRAINING

A. The Contractor shall coordinate O&M training activities through the Commissioning Plan.

The Contractor shall provide training plans for equipment software systems and major components as specified in individual Project Specifications a minimum of ninety (90) Calendar Days prior to beginning verification testing.

B. The Training Plan shall include:
   1. Equipment or Systems involved in training session.
   2. Trainer’s name, company, and experience.
   3. Course outline/syllabus and list of training materials.
   4. Time required for the training session(s).

C. Suggested Training Topics:
   1. Preventive maintenance procedures and frequencies.
   2. Visual inspection parameters including operating sound and noise warnings.
   3. Normal range of gauge and meter readings.
   4. Use of special tools.
   5. Source of operating supplies, lubricants, cleaning materials, etc.
   6. Manufacturer contact names and telephone numbers.
   7. Warranty periods and enforcement procedures.
   8. Design and normal functional operating parameters (capacities, flows, temperatures, speeds, energy consumption, etc.
   9. Breakdown or malfunction conditions and troubleshooting.
   10. Routine testing procedures.

D. The Contractor shall document performance of training session by completing the O&M training form provided by the OAR. Indicate on the form:
   1. Date of training.
   2. List of attendees and their affiliation.
   3. Planned duration of training (hours and/or minutes).
   4. Topics agenda, instructor names & company affiliation, instructor contact information.
   5. Detailed list of planned handouts.
E. The Contractor shall obtain written acceptance of training session from the CxAg on the O&M training form.

F. The Contractor shall record all training sessions and submit for review and approval in accordance with Section 01 79 00 and submit the final documentation after incorporating all edits required by the review in accordance with Section 01 79 00 with a fully executed O&M training form.

PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

A. The Contractor or Installing Subcontractor shall provide all standard testing equipment required to perform startup and initial checkout and the required FPT shall be provided by the Installing Contractor for the equipment being tested.

B. The Contractor or Installing Subcontractor shall provide special equipment, software, tools, and instruments that are only available from the supplier and specific to a piece of testing equipment (test tools) required for adequate testing. The cost of such test tools shall be included in the base bid price to the Contractor and will become the property of the Owner when testing is complete.

C. The Contractor or Installing Subcontractor shall repair any damage to these test tools and calibrate the tools so they are fully functional when turned over to the Owner and provide full documentation on the use, maintenance and calibration with these test tools.

D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Contract Documents.

E. Calibration records for all testing equipment shall be provided to the CxAg through the Contractor.

PART 3 – EXECUTION

3.1 MEETINGS

A. Scoping Meeting

Approximately 30-60 Calendar Days prior to start-up of construction or installation of the Systems to be commissioned, the CxAg will schedule, plan and conduct a Commissioning scoping meeting with the entire Commissioning Team in attendance. Multiple scoping meetings may be required due to multiple features of the Work as the construction progresses. The Contractor shall prepare and distribute meeting minutes to all parties. Information gathered from this meeting will allow the CxAg to revise the Commissioning Plan to its “final” version, which will also be distributed to all parties.

B. Miscellaneous Meetings

Additional meetings may be planned and conducted by the CxAg as construction progresses covering such topics as coordination, deficiency resolution, and planning issues with the respective Installing Subcontractor(s).

3.2 REPORTING

A. The CxAg will provide regular updates and reports to the Commissioning Authority and OAR.
B. The CxAg will regularly communicate with all members of the Commissioning Team to apprise them of the Commissioning progress and scheduling changes through memos, progress reports, etc.

C. The CxAg will prepare Non-Conformance Reports (NCRs) with the review and testing as described in this Section.

D. A final Commissioning Report by the CxAg will be provided focusing on evaluating the Commissioning process issues and identifying areas where the process could be improved. All acquired documentation, logs, minutes, reports, NCRs, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the report. PFCs, FPTs, and monitoring reports will be part of the final Commissioning Report, but will be stored in the Commissioning Record in the O&M Manual(s).

3.3 SYSTEMS TO BE COMMISSIONED

A. The Division 22 and 23 Installing Subcontractor(s) shall take the lead in Commissioning of the following mechanical Systems:
   1. Chiller water piping
   2. Heating water piping
   3. Variable frequency drives
   4. Air handling units
   5. Fan coil units
   6. VAV terminal units
   7. Fan powered terminal units
   8. General exhaust fans
   9. Plumbing systems
   10. HVAC test and balance
   11. Building management and control systems

B. The Division 26 Installing Subcontractor(s) shall take the lead in Commissioning of the following electrical Systems:
   1. Lighting control system
   2. Electrical switchgear
   3. Automatic transfer switches
   4. Uninterrupted power systems
   5. Fault current analysis verification
   6. Grounding systems
   7. Lightning protection systems
   8. Emergency lighting

C. The Installing Subcontractor and suppliers shall take the lead in Commissioning of the following Systems:
   1. Division 34 - Baggage Handling Systems.
2. Division 14 or 34 - Vertical Transportation Systems.

D. The Owner’s representatives will take the lead in Commissioning of the following Systems:
   1. Division 14 or 34 – Passenger Boarding Bridges
   2. Division 21 - Fire suppression systems
   3. Division 27 - Access control and CCTV systems
   4. Division 27 - Communications and technology systems (Ethernet, fiber, phones, etc.)
   5. Division 28 - Fire alarm and voice evacuation system
   6. Division 28 - Public address system

3.4 CONTRACTOR TESTS

   A. The Contractor shall ensure that each Installing Subcontractor and suppliers provide a list and schedule of specified Contractor tests to the CxAg.
   B. Unless specified otherwise, the Contractor shall provide a minimum of four (4) weeks notice to the CxAg prior to execution of specified Contractor’s tests.
   C. The Contractor shall submit test reports to the CxAg and the Architect/Engineer within one (1) week of completion of each test.

3.5 SUBSTANTIATING SYSTEM READINESS

   The Contractor shall:
   A. Construct or install Systems and confirm readiness for testing prior to start of verification test procedures.
   B. Inform the CxAg in writing of the System readiness for verification testing at least four (4) weeks prior to the scheduled start of testing. Complete the SRCs and submit to CxAg.
   C. Perform and document instrumentation and digital controller calibration or provide documentation verifying manufacturer’s performance of calibration prior to verification testing. The CxAg may observe calibration procedures.
   D. Not commence with any system verification testing until such System is documented ready for testing via submittal of the SRC to the CxAg.

3.6 START-UP, PRE-FUNCTIONAL/SYSTEM READINESS CHECKLISTS AND INITIAL CHECKOUT

   The following procedures apply to all equipment and systems to be commissioned as part of the Project.
   A. The Installing Subcontractor(s) responsible for startup of any System shall develop detailed start-up plans for all equipment which are a part of that System. Each piece of equipment will receive a full pre-functional checkout. The CxAg will assist in the development of detailed start-up plan to ensure that each of the manufacturer-recommended procedures has been completed. The parties responsible for the PFC and startup will be identified in the Commissioning scoping meeting and in the PFC. The party responsible for executing FPTs are identified in the testing requirements.
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1. The CxAg will assist in the development of checklists that indicate required procedures to be executed as part of startup and initial checkout of the systems and the party responsible for their execution.

2. The Contractor shall determine which Installing Subcontractor is responsible for executing and documenting each of the line items tasks and shall note the responsible party on the form. Each form may have more than one party responsible for its execution.

3. The Contractor shall ensure that the Installing Subcontractor responsible for the purchase of the equipment develops the full start-up plan by combining or adding to the Architect/Engineer checklists with the manufacturer’s detailed start-up and checkout procedures from the O&M Manual and the normal field checkout sheets.

The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

The full start-up plan may consist of:
   a. The PFCs.
   b. The manufacturer’s standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
   c. The manufacturer’s normal field checkout sheets.

4. The Contractor shall ensure that the Installing Subcontractor submits the full start-up plan to the CxAg for review and approval.

5. The CxAg will review and approve the procedures and the format for documenting them, noting any procedures that need to be added.

6. The full start-up procedures and the approval form may be provided to the Contractor for review and approval, depending upon the management protocol.

B. Execution of PFCs and Start-up.

1. Two (2) weeks prior to start-up, the Contractor, the Installing Subcontractor(s) and suppliers will schedule start-up and checkout with the CxAg. The performance of the PFCs, startup, and checkout are directed and executed by the Installing Subcontractor or supplier with oversight by the Contractor. When checking off PFCs, signatures may be required of other Installing Subcontractors for verification of completion of work.

2. The CxAg shall observe the procedures for each piece of primary equipment, unless there are multiple units, whereby a statistical sampling strategy may be used as approved.

3. The CxAg may observe a sampling of the PFCs and start-up procedures for lower-level components of System equipment.

4. The Contractor, in conjunction with Installing Subcontractor(s), and suppliers shall execute start-up and provide the CxAg with a signed and dated copy of the completed start-up and pre-functional tests and PFCs.

5. Only individuals with direct knowledge and witnessed that a line item task on the PFC was actually performed shall initial or check that item off.
C. Deficiencies, Non-conformance and Approval in Checklists and Start-up.

1. The Contractor shall ensure that the Installing Subcontractor clearly lists any outstanding items of the initial start-up and pre-functional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be submitted to the CxAg within two (2) Working Days of the test completion.

2. The Contractor and the CxAg shall review the report and submit either an NCR or an approval to the Installing Subcontractor. The Contractor and CxAg shall work with the Installing Subcontractor to correct test deficiencies or incomplete items. The Installing Subcontractor or suppliers shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxAg as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original NCR. When satisfactorily completed, the CxAg will recommend approval of the execution of the checklists and start-up of each system using a standard form.

D. Pre-functional Test Form

After the initial Systems submittal phase, the CxAg shall prepare Pre-Functional Test forms for each item of Systems equipment as part of the Commissioning process. The Contractor shall review the respective Pre-Functional Test forms for accuracy, completeness, and provide comments to the CxAg.

3.7 VERIFICATION/FUNCTIONAL PERFORMANCE TESTS

A. Objective

The objective of Functional Performance Tests (FPTs) and verification tests is to demonstrate that each System is operating according to the documented design intent and the requirements within the Contract Documents. Functional testing facilitates bringing the Systems from a state of Substantial Completion to full dynamic operation. Each System shall be operated through all modes of operation where there is a specified System response. The Contractor or Installing Subcontractor shall verify each sequence within the sequences of operation.

B. FPTs and verification testing may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results. The CxAg will determine which method is most appropriate for tests that do not have a method specified. Simulating conditions shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Contractor and the Installing Subcontractor executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor and the Installing Subcontractor shall return all affected Systems, due to these temporary modifications, to their pre-test condition.

C. The Contractor and the Installing Subcontractor shall perform verification test procedures as outlined in the approved verification test plan.
D. The Installing Subcontractor shall provide input into the Contractor’s master scheduling process with regards to timing and duration of verification test procedures.

E. The CxAg will review and provide comment on final detailed verification test procedures. The Contractor and the Installing Subcontractor shall develop the verification test procedures from information incorporated in the System shop drawings and submittals.

The CxAg will provide feedback on the efficiency of the procedures and possible alternate approaches to achieving the same results.

3.8 FUNCTIONAL PERFORMANCE TEST FORMS

A. The Contractor and the Installing Subcontractor(s) shall provide personnel and equipment, to perform the FPT procedures. After the finalization of the Pre-Functional Test forms, the CxAg will prepare FPT forms for each System which is a part of the Commissioning process. The Contractor shall review the respective FPT forms for accuracy, completeness, and provide comments to the CxAg.

B. Sample FPT forms are required with each Commissioning Plan submission for acceptance.

3.9 CORRECTIVE ACTIONS

A. The Contractor shall perform or ensure the Installing Subcontractor(s) or suppliers provide Corrective Actions for the resolution of deficiencies identified in the Commissioning Issue Log.

B. The CxAg will document deficiencies discovered during the Commissioning process on an Issue Log within one (1) Working Day of discovery.

1. Deficiency Identification Process:
   a. Document date of identification.
   b. Describe nature of deficiency.
   c. Distribute original Issue Log to the Installing Contractor’s Commissioning Coordinator.
   d. Distribute copies to:
      1) Contractor
      2) Architect/Engineer
      3) Other contractors impacted by deficiency.

2. The Contractor shall ensure the Installing Subcontractor performs the following:
   a. Obtains the original form.
   b. Records the date of direction.
   c. Provides a description of Corrective Action required.
   d. Records the name of person issuing the direction.
   e. Determines the estimated date to complete the Corrective Action.
   f. Distributes the original form to CxAg.
   g. Distributes copies of the form to:
1) Architect/Engineer
2) Contractor
3) Installing Subcontractor's Commissioning Coordinator
4) Other contractors impacted by the deficiency

3. The Contractor shall ensure the Installing Subcontractor or supplier completes the following actions when Corrective Actions are completed by the Installing Subcontractor, supplier, and/or the Contractor:
   a. Obtains the original form.
   b. Records date of correction.
   c. Provides a description of final equipment status or Corrective Action performed.
   d. Records the name of Installing Subcontractor that performed the work.
   e. Submits the original form using normal submittal procedures through the Contractor to the CxAg.
   f. Distributes copies of the form:
      1) Architect/Engineer
      2) Contractor’s Commissioning Coordinator.
      3) Commissioning Coordinator for the Installing Subcontractor or the supplier
      4) Other contractors impacted by the deficiency.

4. The CxAg will perform a verification of the Corrective Action completion and record:
   a. Date of the retest.
   b. Determined status - Resolved or Corrective Action required.
   c. Name of person performing verification.
   d. Distributes copies to:
      1) Architect/Engineer
      2) Installing Contractor’s Commissioning Coordinator.
      3) Contractor.
      4) Other contractors impacted by deficiency.

C. Cost of Retesting

The cost for retesting a Pre-functional Test or PFT due to the action of, or a deficiency caused by, the Contractor or Installing Subcontractor shall be the sole responsibility of the Contractor. Any costs for retesting not due to the actions of, or a deficiency caused by, the Contractor or Installing Subcontractor, may be negotiated with the Owner in accordance with the Contract Documents.

D. Failure Due to Manufacturer Defect

If ten (10) percent or three (3) of any individual item (size alone does not constitute a difference), whichever is greater, fails to perform in accordance with the Contract
Documents (mechanically or substantively) due to manufacturing defect, which in the sole determination of the OAR renders the item unable to meet its performance requirements, all identical units will be considered unacceptable. In such a case, the Contractor shall provide the OAR and CxAg with the following:

1. Within one (1) week of notification, the Installing Subcontractor or manufacturer’s representative shall examine all other identical units and record the findings. The findings shall be provided within two (2) weeks of the original notice.

2. Within two (2) weeks of the original notification, the Installing Subcontractor or manufacturer’s representative shall provide a signed and dated, written explanation of the problem, cause of failure, and all proposed solutions including full equipment submittals of the original installation.

3. The OAR is solely responsible to determine whether a replacement of all identical units or a repair is acceptable.

4. Upon acceptance of a solution to the deficiency or non-conformance, the Contractor, Installing Subcontractor, and/or manufacturer’s representative shall replace or repair all identical items and extend the warranty accordingly, if the original equipment warranty had begun, at no cost to the Owner. The replacement/repair work shall proceed with reasonable speed beginning within one (1) week from when parts can be obtained.

E. Approval

The CxAg notes each satisfactorily demonstrated FPT on the test form. The CxAg recommends acceptance of each test using a standard form. The OAR will provide any final approval on each test using the same form and will provide a signed copy to the CxAg and the Contractor.

3.10 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

A. The Contractor shall provide a demonstration of the operation of the Commissioned Systems at approximately ten (10) months into the initial warranty period. The CxAg will witness the demonstration of the Systems and prepare an “Opposite Season” report as well as a “Lessons Learned” report for the Project if required by the Commissioning Plan.

B. The intent of the ten (10) month demonstration will be to identify any operational concerns, document suggested solutions and review the long-term operational and re-commissioning requirements of the Systems.

C. The Contractor shall use FPT forms to document performance.

3.11 OPERATION AND MAINTENANCE MANUALS

A. The following O&M Manual requirements do not replace O&M Manual documentation requirements elsewhere in the respective Project Specification Sections.

B. The Architect/Engineer shall compile and prepare design documentation for all Systems specified in each division of the Specification Sections and deliver this documentation to the Contractor for inclusion in the O&M Manual(s) prior to the training of Owner personnel.

C. The CxAg shall receive a copy of the O&M Manual(s) for review.
D. Field checkout sheets and logs should be provided to the CxAg for inclusion in the Commissioning Record Book section of the O&M Manual(s).

E. Review of the Commissioning related sections of the O&M Manual(s) shall be performed by the Architect/Engineer, the Contractor, and the CxAg.

3.12 TRAINING OF OWNER PERSONNEL

A. The Contractor shall be responsible for training coordination, scheduling, and ultimately to ensure that training of the Owner’s personnel is completed in accordance with the requirements of this Section.

B. The CxAg shall be responsible for witnessing and approving the content and adequacy of the training of the Owner personnel for commissioned Systems.

3.13 WRITTEN WORK PRODUCTS

The Contractor’s written work products shall consist of the start-up and initial checkout plan described and the completed start-up, initial checkout and PFCs, manufacturer’s factory documentation and testing; field testing inspection forms, Contractor inspection forms, and O&M Manual(s) both in electronic and hard copy in accordance with this Section. These work products shall be submitted to the CxAg to be included in the final Commissioning Report as required.

PART 4 – FORMS

The forms and documents to be used for the Commissioning processes shall be in accordance with the Building Commissioning Association (BCA), AABC Commissioning Group (ACG), National Environmental Balancing Bureau (NEBB), American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), or the University of Wisconsin or as otherwise provided or approved for the Project by the CxAg and the OAR.

A. Provide pictures of equipment and issues identified in the field.

B. Provide demonstration of trend logging performance of the building automation system.

C. Maintain consistency throughout Commissioning Plan and final Commissioning Report for all approved forms.

D. Provide digital hyperlinks for all Commissioning Report sections

PART 5 – MEASUREMENT AND PAYMENT

Not Used.

– END OF SECTION –
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. Owner's Project Requirements and Basis-of-Design documentation are included by reference for information only.

1.2 SUMMARY

A. Section Includes:
   1. General requirements for coordinating and scheduling commissioning.
   2. Commissioning meetings.
   3. Commissioning reports.
   4. Use of test equipment, instrumentation, and tools for commissioning.
   5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
   6. Commissioning tests and commissioning test demonstration.
   7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:
   1. Section 01 33 00 "Submittal Procedures" for submittal procedures requirements for commissioning.
   2. Section 01 77 00 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.
   3. Section 01 78 23 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal.
   4. Section 21 08 00 "Commissioning of Fire Suppression" for technical commissioning requirements for fire suppression.
   5. Section 23 08 00 "Commissioning of HVAC" for technical commissioning requirements for HVAC.
   6. Section 26 08 00 "Commissioning of Electrical Systems" for technical commissioning requirements for electrical systems.

1.3 ALLOWANCES

A. Labor and management costs for the performance of commissioning.

B. The following are excluded from the commissioning allowance:
   1. Equipment and systems installation, startup, and field quality-control testing indicated in the Contract Documents.
   2. Test equipment, instrumentation, and tools (including, but not limited to, proprietary test equipment, instrumentation, and tools) required to perform tests.
   3. Work to correct commissioning issues.
   4. Work to repeat tests when equipment and systems fail acceptance criteria.
1.4 DEFINITIONS

A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests and commissioning test demonstrations.

B. Basis-of-Design Document: A document prepared by Owner, Architect, or Commissioning Authority that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.

C. Commissioning Authority: An entity engaged by Owner, and identified in Section 01 10 00 "Summary," to evaluate Commissioning-Process Work.

D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation requirements of commissioning.

E. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities.

F. Construction Phase Commissioning Completion: The stage of completion and acceptance of commissioning when resolution of deficient conditions and issues discovered during commissioning and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date Construction Phase Commissioning Completion is achieved. See Section 01 77 00 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.

1. Commissioning is complete when the work specified in this Section and related Sections has been completed and accepted, including, but not limited to, the following:

   a. Completion of tests and acceptance of test results.
   b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
   c. Comply with requirements in Section 01 79 00 "Demonstration and Training."
   d. Completion and acceptance of submittals and reports.

G. Owner's Project Requirements: A document written by Owner, Architect, or Commissioning Authority that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

H. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Architect-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.

I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

J. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
K. Sampling Procedures and Tables for Inspection by Attributes: As defined in ASQ Z1.4.

1.5 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning.
2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning.
3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning.
4. Appointed team members shall have the authority to act on behalf of the entity they represent.

B. Members Appointed by Owner:

1. Commissioning authority, plus consultants that Commissioning Authority may deem appropriate for a particular portion of the commissioning.
2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning.
3. Architect, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning.

1.6 INFORMATIONAL SUBMITTALS

A. Comply with requirements in Section 01 33 00 "Submittal Procedures" for submittal procedures general requirements for commissioning.

B. Commissioning Plan Information:

1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors to the performance of the various commissioning requirements.
2. Schedule of commissioning activities, integrated with the construction schedule. Comply with requirements in Section 01 32 00 "Construction Progress Documentation" for construction schedule general requirements for commissioning.
3. Contractor personnel and subcontractors to participate in each test.
4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. Commissioning Coordinator Letter of Authority:

1. Within 10 days after approval of Commissioning Coordinator qualifications, submit a letter of authority for Commissioning Coordinator, signed by a principal of Contractor's firm. Letter shall authorize Commissioning Coordinator to do the following:

a. Make inspections required for commissioning.
b. Coordinate, schedule, and manage commissioning of Contractor, subcontractors, and suppliers.
c. Obtain documentation required for commissioning from Contractor, subcontractors, and suppliers.
d. Report issues, delayed resolution of issues, schedule conflicts, and lack of cooperation or expertise on the part of members of the commissioning team.

F. Commissioning Coordinator Qualification Data: For entity coordinating Contractor's commissioning activities to demonstrate their capabilities and experience.

1. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

G. List test instrumentation, equipment, and monitoring devices. Include the following information:

1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
2. Brief description of intended use.
3. Calibration record showing the following:
   a. Calibration agency, including name and contact information.
   b. Last date of calibration.
   c. Range of values for which calibration is valid.
   d. Certification of accuracy.
   e. N.I.S.T. traceability certification for calibration equipment.
   f. Due date of the next calibration.

H. Test Reports:

1. Pre-Startup Report: Prior to start up of equipment or a system, submit signed, completed construction checklists.
2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
3. Commissioning Issues Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit print-out of log of alarms that occurred since the last log was printed.

I. Construction Checklists:

1. Material checks.
2. Installation checks.
3. Startup procedures, where required.

1.7 CLOSEOUT SUBMITTALS

A. Commissioning Report:
1. At Construction Phase Commissioning Completion, include the following:
   a. Pre-startup reports.
   b. Approved test procedures.
   c. Test data forms, completed and signed.
   d. Progress reports.
   e. Commissioning issues report log.
   f. Commissioning issues reports showing resolution of issues.
   g. Correspondence or other documents related to resolution of issues.
   h. Other reports required by commissioning.
   i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction Phase Commissioning Completion.
   j. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction Phase Commissioning Completion.

C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Commissioning Coordinator Qualifications:
   1. Documented experience commissioning systems of similar complexity to those contained in these documents on at least three projects of similar scope and complexity.
   2. Certification of commissioning process expertise. The following certifications are acceptable. Owner reserves the right to accept or reject certifications as evidence of qualification.
      c. Accredited Commissioning Process Authority Professional, by University of Wisconsin.
      d. Accredited Commissioning Process Manager, by University of Wisconsin.
      e. Accredited Green Commissioning Process Provider, by University of Wisconsin.

B. Calibration Agency Qualifications: Certified by The American Association of Laboratory Accreditation that the calibration agency complies with minimum requirements of ISO/IEC 17025.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Test equipment and instrumentation required to perform the commissioning shall remain the property of Contractor unless otherwise indicated.

B. Test equipment and instrumentation required to perform commissioning shall comply with the following criteria:
1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.

2. Calibrated and certified.
   
a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags permanently affixed.

b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.

3. Maintain test equipment and instrumentation.

4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate or perform work on its equipment.

1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.

2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

2.3 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:


2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.

3. Record report on compact disk.

4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

1. Include a table of contents and an index to each test.

2. Include major tabs for each Specification Section.

3. Include minor tabs for each test.

4. Within each minor tab, include the following:

   a. Test specification.

   b. Pre-startup reports.

   c. Approved test procedures.

   d. Test data forms, completed and signed.
e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 PREPARATION

A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.2 CONSTRUCTION CHECKLISTS

A. Construction checklists cannot modify or conflict with the Contract Documents.

B. Create construction checklists based on actual systems and equipment to be included in Project.

C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment, if applicable.

1. Services connection requirements, including configuration, size, location, and other pertinent characteristics.
2. Included optional features.
3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness and lack of damage.
4. Installation Checks:
   a. Location according to Drawings and approved Shop Drawings.
   b. Configuration.
   c. Compliance with manufacturers' written installation instructions.
   d. Attachment to structure.
   e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
   f. Utility connections are of the correct characteristics, as applicable.
   g. Correct labeling and identification.
   h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.

D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, minimum.

E. Performance Tests:

1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.

3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.

4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.

5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.

F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction Phase Commissioning Completion. When approved, deferred construction checklists may be completed after date of Construction Phase Commissioning Completion. Include the following in request for Certificate of Construction Phase Commissioning Completion:

1. Identify deferred construction checklists by number and title.
2. Provide a target schedule for completion of deferred construction checklists.
3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.

G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction Phase Commissioning Completion. When approved, delayed construction checklists may be completed after date of Construction Phase Commissioning Completion. Include the following in request for Certificate of Construction Phase Commissioning Completion:

1. Identify delayed construction checklist by construction checklist number and title.
2. Provide a target schedule for completion of delayed construction checklists.
3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

3.3 GENERAL EXECUTION REQUIREMENTS

A. Schedule and coordinate commissioning with the construction schedule.

B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.

C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.

D. Report test data and commissioning issue resolutions.

E. Schedule personnel to participate in and perform Commissioning-Process Work.

F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:

1. Operating the equipment and systems they install during tests.
2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.
3.4 COMMISSIONING COORDINATOR RESPONSIBILITIES

A. Management and Coordination: Manage, schedule, and coordinate commissioning, including, but not limited to, the following:

1. Coordinate with subcontractors on their commissioning responsibilities and activities.
2. Obtain, assemble, and submit commissioning documentation.
3. Conduct periodic on-site commissioning meetings. Comply with requirements in Section 01 31 00 "Project Management and Coordination."
4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the construction schedule. Update schedule at specified intervals.
5. Review and comment on preliminary test procedures and data forms.
6. Report inconsistencies and issues in system operations.
7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
8. Direct and coordinate test demonstrations.
9. Coordinate witnessing of test demonstrations by Owner's witness.
10. Coordinate and manage training. Be present during training sessions to direct video recording, present training and direct the training presentations of others. Comply with requirements in Section 01 79 00 "Demonstration and Training."
11. Prepare and submit specified commissioning reports.
12. Track commissioning issues until resolution and retesting is successfully completed.
13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.

3.5 COMMISSIONING TESTING

A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.

B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published commissioning schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning.

C. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

D. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.

E. Test Procedures and Test Data Forms:
1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
3. Completed test data forms are the official records of the results of tests.
4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
5. Review preliminary test procedures and test data forms and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:
   a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
   b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.
6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

F. Performance of Tests:

1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
2. Perform and complete each step of the approved test procedures in the order listed.
3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

G. Performance of Test Demonstration:

1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.
2. Notify Owner's witness at least five days in advance of each test demonstration.
3. Perform and complete each step of the approved test procedures in the order listed.
4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.
a. Exception for Failure of Owner’s Witness to Attend: Failure of Owner’s witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness, and shall note the absence of Owner's witness at the scheduled time and place.

7. False load test requirements are specified in related sections.

a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Architect's written approval.

H. Deferred Tests:

1. Deferred Tests List: Identify, in the request for Certificate of Construction Phase Commissioning Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction Phase Commissioning Completion as follows:

   a. Identify deferred tests by number and title.
   b. Provide a target schedule for completion of deferred tests.

2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Architect and Commissioning Authority at least five working days in advance of tests.

3. Where deferred tests are specified, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

I. Delayed Tests:

1. Delayed Tests List: Identify, in the request for Certificate of Construction Phase Commissioning Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction Phase Commissioning Completion. Include the following in the request for Certificate of Construction Phase Commissioning Completion:

   a. Identify delayed tests by test number and title.
   b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.

2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Architect and Commissioning Authority at least 5 working days in advance of tests.

3. Where delayed tests are approved, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule delayed tests to
minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

J. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.
2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:
   a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
   b. Submit commissioning compliance issue report form within 48 hours of the test.
   c. Determine the cause of the failure.
   d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.
   a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.
   b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
   c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
   d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.
6. Diagnose and correct failed test demonstrations as follows:
   a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
   b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
   c. Record the results of each step of the diagnostic procedure.
   d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
   e. Determine and record corrective measures.
   f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.
7. Retest:
a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.

b. For each repeated test demonstration, submit a new test data form, marked "Retest."

8. Do not correct commissioning compliance issues during test demonstrations.

a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than 30 minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

3.6 COMMISSIONING MEETINGS

A. Schedule and conduct commissioning meetings. Comply with requirements in Section 01 31 00 "Project Management and Coordination."

3.7 SEQUENCING

A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:

1. Construction Checklists:

   a. Material checks.
   b. Installation checks.
   c. Start up, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
   d. Performance Tests:

      1) Static tests, as appropriate.
      2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
      3) Equipment and assembly performance tests.
      4) System performance tests.
      5) Intersystem performance tests.

2. Commissioning tests.

B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.
C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Architect if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.

D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.8 SCHEDULING

A. Commence commissioning as early in the construction period as possible.

B. Commissioning Schedule: Integrate commissioning into Contractor's construction schedule. See Section 01 32 00 "Construction Progress Documentation."
   1. Include detailed commissioning activities in monthly updated Contractor's construction schedule and short interval schedule submittals.
   2. Schedule the start date and duration for the following commissioning activities:
      a. Submittals.
      b. Preliminary operation and maintenance manual submittals.
      c. Installation checks.
      d. Startup, where required.
      e. Performance tests.
      f. Performance test demonstrations.
      g. Commissioning tests.
      h. Commissioning test demonstrations.
   3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
   4. Determine milestones and prerequisites for commissioning. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short interval schedule submittals.

C. Two-Week Look-Ahead Commissioning Schedule:
   1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning.
   2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
   3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

D. Owner's Witness Coordination:
   2. Notify Architect of commissioning schedule changes at least \[\text{two} \ <\text{Insert number}>\] work days in advance for activities requiring the participation of Owner's witness.
3.9 COMMISSIONING REPORTS

A. Test Reports:

1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:

   a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
   b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.
   c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
   d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
   e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.

2. Test data reports include the following:

   a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
   b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
   c. Signatures of individuals performing and witnessing tests.
   d. Data trend logs accumulated overnight from the previous day of testing.

3. Commissioning Compliance Issues Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:

   a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
   b. Action distribution list.
   c. Report date.
   d. Test number and description.
   e. Equipment identification and location.
   f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
   g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
   h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.

j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.

k. Schedule for retesting.

4. Weekly progress reports include information for tests conducted since the preceding report and the following:

a. Completed data forms.
b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
c. Activities scheduled but not conducted per schedule.
d. Commissioning compliance issue report log.
e. Schedule changes for remaining Commissioning-Process Work, if any.

5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.

a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
b. Attach to the data form printed trend log data collected during the test or test demonstration.
c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.

6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."

a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.

3.10 CERTIFICATE OF CONSTRUCTION PHASE COMMISSIONING COMPLETION

A. When Contractor considers that construction phase commissioning, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Commissioning Authority through Architect a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning.

B. On receipt of Contractor's list, Commissioning Authority will make an inspection to determine whether the construction phase commissioning or designated portion thereof is complete. If Commissioning Authority's inspection discloses items, whether included on Contractor's list,
which is not sufficiently complete as defined in "Construction Phase Commissioning Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction Phase Completion, complete or correct such items on notification by Commissioning Authority. In such case, Contractor shall then submit a request for another inspection by Commissioning Authority to determine construction phase commissioning completion.

C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Architect's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense.

D. When construction phase commissioning or designated portion is complete, Commissioning Authority will prepare a Certificate of Construction Phase Commissioning that shall establish the date of completion of construction phase commissioning. Certificate of Construction Phase Commissioning Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION
SPECIAL PROVISION TO ITEM 361 REPAIR OF CONCRETE PAVEMENT

Item 361, “Repair of Concrete Pavement” of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

**Article 361.5 “Measurement”** is replaced as follows:

The work performed, materials furnished, equipment, labor, tools and incidentals will not be measured but will be subsidiary to pertinent items.

**Article 361.6 “Payment”** is replaced as follows:

The work performed, materials furnished, equipment, labor, tools and incidentals will not be paid but will be subsidiary to pertinent items.

– END OF SECTION –
SPECIAL PROVISION TO ITEM 429 CONCRETE STRUCTURE REPAIR

Item 429, “Concrete Structure Repair” of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 429.1 “Materials” is amended as follows:
- DMS-4675, “Cementitious Grouts and Mortars for Miscellaneous Applications”

The work performed, materials furnished, equipment, labor, tools and incidentals will not be measured but will be subsidiary to pertinent items.

Article 429.4 “Measurement” is replaced as follows:

The work performed, materials furnished, equipment, labor, tools and incidentals will not be measured but will be subsidiary to pertinent items.

Article 429.5 “Payment” is replaced as follows:

The work performed, materials furnished, equipment, labor, tools and incidentals will not be paid but will be subsidiary to pertinent items.

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SPECIAL PROVISION TO ITEM 434 BRIDGE BEARINGS

Item 434, “Bridge Bearings” of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 434.4 “Measurement” is replaced as follows:
The work performed, materials furnished, equipment, labor, tools and incidentals will not be measured but will be subsidiary to pertinent items.

Article 434.5 “Payment” is replaced as follows:
The work performed, materials furnished, equipment, labor, tools and incidentals will not be paid but will be subsidiary to pertinent items.

– END OF SECTION –
SPECIAL PROVISION TO ITEM 442 METAL FOR STRUCTURES

Item 442, “Metal for Structures” of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

**Article 442.4 “Measurement”** is replaced as follows:

The following items will be measured as follows. Each item shall include materials furnished, equipment, labor, tools and incidentals necessary to complete the work.

- Round column protection; square column protection; bollards – new; bollards – repair; rail anchoring system – repair; and ladder – new shall be measured by each.
- Railing – new shall be measured by the linear foot.

**Article 442.5 “Payment”** is replaced as follows:

The work performed and materials furnished in accordance with this item and measured as provided under “Measurement” will be paid for as follows:

5.1 Round Column Protection – per each.
5.2 Square Column Protection – per each.
5.3 Bollards – New – per each.
5.4 Bollards – Repair – per each.
5.5 Rail Anchoring System – Repair – per each.
5.6 Ladder – New – per each.
5.7 Railing – New – per LF.

– END OF SECTION –
SPECIAL PROVISION TO ITEM 446 FIELD CLEANING AND PAINTING STEEL

Item 446, “Field Cleaning and Painting Steel” of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 446.5 “Measurement” is replaced as follows:
The work performed, materials furnished, equipment, labor, tools and incidentals will not be measured but will be subsidiary to pertinent items.

Article 446.6 “Payment” is replaced as follows:
The work performed, materials furnished, equipment, labor, tools and incidentals will not be paid but will be subsidiary to pertinent items.

– END OF SECTION –
SPECIAL PROVISION TO ITEM 447 STRUCTURAL BOLTING

Item 447, “Structural Bolting” of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 446.5 “Measurement” is replaced as follows:
The work performed, materials furnished, equipment, labor, tools and incidentals will not be measured but will be subsidiary to pertinent items.

Article 446.6 “Payment” is replaced as follows:
The work performed, materials furnished, equipment, labor, tools and incidentals will not be paid but will be subsidiary to pertinent items.

– END OF SECTION –
SPECIAL PROVISION TO ITEM 461 STRUCTURAL PLATE STRUCTURES

Item 461, “Structural Plate Structures” of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

**Article 461.4 “Measurement”** is replaced as follows:

The work performed, materials furnished, equipment, labor, tools and incidentals will not be measured but will be subsidiary to pertinent items.

**Article 461.5 “Payment”** is replaced as follows:

The work performed, materials furnished, equipment, labor, tools and incidentals will not be paid but will be subsidiary to pertinent items.

– END OF SECTION –
SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Demolition and removal of selected portions of a building or structure.
   2. Repair procedures for selective demolition operations.

B. Related Requirements:
   1. Division 01 "General Requirements".

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.4 PREINSTALLATION MEETINGS

1.5 ACTION SUBMITTALS

1.6 INFORMATIONAL SUBMITTALS

   1. Qualification Data: For demolition firm. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
B. Proposed Environmental Protection, Dust-Control and Noise-Control Measures: Submit report, including drawings, that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

1.7 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

C. Storage or sale of removed items or materials on-site will not be permitted.

D. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

2.2 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

   1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

   2. Use materials whose installed performance equals or surpasses that of existing materials.

B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services indicated to remain and protect them against damage during selective demolition operations.
### 3.3 PREPARATION

**A. Temporary Facilities:** Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
3. Cover and protect furniture, furnishings, and equipment that have not been removed.
4. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified.

### 3.4 POLLUTION CONTROLS

**A. Dust Control:** Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

1. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.

**B. Disposal:** Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

### 3.5 SELECTIVE DEMOLITION, GENERAL

**A. General:** Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

B. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

3.7 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

C. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

D. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Comply with Construction Waste Management and Disposal requirements.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.9 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19
SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:

1. Walls and partitions.
2. Smoke barriers.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each type of through penetration firestop system product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Through-Penetration Firestopping Schedule: Submit, for information only, a Through-Penetration Firestopping Schedule indicating the type of through-penetration firestop system to be installed for each penetration. Indicate each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of testing and inspection agency acceptable to the authorities having jurisdiction that evidences compliance with requirements for each condition indicated, and listed in the "Through Penetration Firestopping Schedule" at the end of Part 3 of this Section.

1. Submit documentation, including illustrations, from Underwriters Laboratories applicable to each through-penetration firestop.
2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.

B. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

C. At Project Closeout, submit a Record Schedule, signed by the Installer, of systems installed, the UL design designations, and the location of each system. The submittal must have the Installer's signature.
1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified or licensed, by firestop system manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its firestop system materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Firestop tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, ITS, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.

2. Through-penetration firestop systems identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements.

   a. Through-penetration firestop systems corresponding to those indicated by reference to through-penetration firestop system designations listed by the following:

      1) UL in "Fire Resistance Directory."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multi-component materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.
1.7  COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing and provide through-penetration firestop systems to accommodate sizes of sleeves, openings, core-drilled holes, or cut openings.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Architect, Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1  PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.

   1. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814 or UL 1479, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814 or UL 1479, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

   1. Penetrations located in construction containing fire-protection-rated openings.

   2. Penetrating items larger than 4 inch (100 mm) diameter nominal pipe or 16 square inch (10,323 square mm) in overall cross-sectional area.

   3. Provide T-rating not less than the required rating of the element penetrated, but not less than 1 hour, minimum.

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

   1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
E. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide through-penetration firestop systems that are UL listed for the penetrations listed in UL-Classified Through Penetration Fire Stopping Assemblies in the Schedule at the end of Part 3 of this Section.

2.3 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. VOC Content: Provide penetration firestopping that complies 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.
4. Plastic Foam Adhesives: 50 g/L.
5. Adhesives for Porous Materials (Except Wood): 50 g/L.
6. Fiberglass Adhesives: 80 g/L.
7. Primers, Sealers and Undercoaters: 200 g/L.

C. Accessories: Provide components for each through-penetration firestop system needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
   a. Slag-/rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.

2. Temporary forming materials.
5. Steel sleeves.

D. Gypsum Products: The use of gypsum products for through-penetration firestopping is strictly prohibited.
2.4 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

B. Blocks/Plugs: Intumescent flexible block/plug suitable for reuse in re-penetration of openings. Blocks shall allow up to 12 inches (305 mm) of unreinforced annular space.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.

2.5 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without damaging substrate or disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner may engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.

1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.
B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.

C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

B. Identify fire-resistance-rated construction (including walls, shaft enclosures, partitions, and smoke barriers) with signs or stenciling permanently installed above suspended ceilings or in other concealed spaces. The lettering shall be 3 inches (75 mm) in height and spaced 12 feet (3658 mm) on center:

1. The words ____-HOUR FIRE AND SMOKE WALL - PROTECT ALL PENETRATIONS."
   a. Replace blank with actual fire-resistance rating.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.
3.7 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

A. Select UL-classified systems from the attached schedule and submit "Through-Penetration Firestopping Schedule" as specified in Article 1.3, Submittals.
### PENETRATION FIRESTOPPING

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<table>
<thead>
<tr>
<th>CONSTRUCTION</th>
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<th>WALL PENETRATION SYSTEMS (FIRST ALPHA COMPONENT = C OR W)</th>
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</thead>
<tbody>
<tr>
<td><strong>TYPE OF PENETRANT</strong></td>
<td><strong>CONCRETE FLOORS WITH A MINIMUM THICKNESS LESS THAN OR EQUAL TO 5 INCHES (122 MM)</strong></td>
<td><strong>FLOOR-CEILING ASSEMBLIES CONSISTING OF CONCRETE WITH MEMBRANE PROTECTION</strong></td>
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<tr>
<td><strong>NO PENETRATING ITEMS</strong></td>
<td>C-AJ-0001-0099 or F-A-0001-0999</td>
<td>F-C-1001-1509</td>
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<tr>
<td><strong>ELECTRICAL CABLES</strong></td>
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<td>F-C-3001-3999</td>
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<td><strong>CABLE TRAYS WITH ELECTRICAL CABLES</strong></td>
<td>C-AJ-4001-4999 or F-A-4001-4999</td>
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<td><strong>INSULATED PIPES</strong></td>
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<tr>
<td><strong>MISCELLANEOUS ELECTRICAL PENETRANTS</strong></td>
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<td><strong>MISCELLANEOUS MECHANICAL PENETRANTS</strong></td>
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<td><strong>GROUPINGS OF PENETRATIONS</strong></td>
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<td>C-BK-8001-8999 or F-B-8001-8999</td>
</tr>
</tbody>
</table>

**Remarks:** For each location where a fire-resistance-rated floor or wall assembly is penetrated, provide a UL-listed penetration firestop system selected from the applicable UL number range listed above that complies with Section 978/413 "Penetration Firestopping" and that is suitable for the penetration conditions indicated for the Project.

**END OF SECTION 07 84 13**
SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fire-resistive joint systems for the following:

1. Head-of-wall joints.
2. Wall-to-wall joints.

1.2 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

1.3 ACTION SUBMITTALS

A. Product Data: Submit product data for each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Fire Resitive Joint System Schedule: Submit, for information only, a Fire Resitive Joint System Schedule indicating the type of fire resistive joint system to be installed for each joint. Indicate each kind of construction condition. Include fire resistive joint design designation of testing and inspection agency acceptable to the authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

B. Product Certificates: Signed by manufacturers of fire resistive joint system products certifying that products furnished comply with requirements.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified or licensed by the fire resistive joint system manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its fire resistive joint system materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 2 "Performance Requirements" Article:

1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.

2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 2 "Performance Requirements" Article and comply with the following:
   a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
   b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

B. Joint Systems In and Between Fire Resistance Rated Constructions: Provide systems with assembly ratings not less than that equaling or exceeding fire-resistance rating of constructions in which joints are located, as determined by UL 2079.

2.2 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide fire resistive joint systems indicated for each application in the Fire-Resistive Joint System Schedule at the end of Part 3.

2.3 JOINT FIRESTOPPING

A. Compatibility: Provide joint firestopping systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistant joint system manufacturer based on testing and field experience.

B. VOC Content: Provide joint firestopping systems that 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.
4. Plastic Foam Adhesives: 50 g/L.
5. Adhesives for Porous Materials (Except Wood): 50 g/L.
6. Fiberglass Adhesives: 80 g/L.
7. Primers, Sealers and Undercoaters: 200 g/L.

C. Accessories: Provide components of joint firestopping system, including forming materials, that are needed to install fill materials and to comply with Part 2 "Performance Requirements" Article. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of Work.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

A. Install joint firestopping systems to comply with Part 2 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner may engage a qualified independent inspecting agency to inspect fire-resistive joint systems and to prepare inspection reports.

   1. Inspecting agency will state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.

B. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and inspecting agency has approved installed fire-resistive joint systems.

C. If deficiencies are found, repair or replace fire-resistive joint systems so they comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.6 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Designation System for Joints in or between Fire-Resistance-Rated Constructions: Alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN.

B. Designation System for Joints at the Intersection of Fire-Resistance-Rated Floor or Floor/Ceiling Assembly: Alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHDG.

C. Bottom-of-Wall, Fire-Resistive Joint Systems: UL-Classified (BW Series) systems as required to maintain bottom of wall fire rating indicated.

D. Wall-To-Wall, Fire-Resistive Joint Systems: UL-Classified (WW-Series) system as required to maintain floor to wall fire rating indicated.

END OF SECTION 07 84 43
SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes non-structural metal framing assemblies.

1.2 PRE-INSTALLATION MEETING
A. Preconstruction Conference: Prior to start of the non-structural metal framing work, and at the Contractor's direction, meet at Project site and review the installation procedures and coordination with other work. Meeting shall include Contractor, Architect and major material manufacturer as well as the Installer and other subcontractors whose work must be coordinated with the non-structural metal framing and the gypsum wallboard work.

1.3 ACTION SUBMITTALS
A. Product Data: Submit product data for each product indicated.

1.4 QUALITY ASSURANCE
A. Fire-Test-Response Characteristics: For non-structural metal framing assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.


1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
1.6 FIELD CONDITIONS

A. Comply with ASTM C 754 requirements or wallboard material manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. General: For fire rated assemblies, provide materials, including accessories and fasteners produced by one manufacturer, or, when products of more than one manufacturer are used in a rated system, they shall be acceptable to authorities having jurisdiction.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 PERFORMANCE REQUIREMENTS

A. Gypsum Board Assembly Deflections:

1. Typical Walls: Wall assemblies shall be constructed for deflection not to exceed 1/240 of the wall height when subjected to a positive and negative pressure of 5 psf (239 Pa).

2.3 STEEL PARTITION AND SOFFIT FRAMING

A. General: Provide steel framing members sized and spaced as indicated but not less than that required to comply with ASTM C 754 under the maximum deflection conditions specified under Article 'Assembly Performance Requirements.'


B. Steel Studs and Runners: ASTM C 645, in minimum depth indicated in partition type details; one of the following:

1. Allsteel & Gypsum Products, Inc.
2. CEMCO.
3. Clark Dietrich.
5. Craco Manufacturing, Inc.
6. Custom Stud, Inc.
7. MarinoWARE.
10. SCAFCO Corporation.
11. Telling Industries.
12. The Steel Network.
13. United Metal Products.
14. Minimum Base Metal Thickness:
   a. Typical: As required to comply with deflection criteria but not less than 0.0179 inch (0.45-mm).
15. Depth: As indicated.

C. Cold-Rolled Channel Bridging: For channel bridging for fixture attachment or lateral bracing provide 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flange:
   1. Depth: 1-1/2 inches (38.1 mm).
   2. Clip Angle: 1-1/2 by 1-1/2 inch (38.1 by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
   2. Depth: 7/8 inch (22.2 mm).

E. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members securely to substrates involved; complying with the recommendations of the gypsum board manufacturers for applications indicated.

2.4 AUXILIARY MATERIALS
   A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine substrates to which non-structural metal framing attaches or abuts, installed door frames and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLING STEEL FRAMING, GENERAL
   A. General: Install steel framing to comply with ASTM C 754, ASTM C 840 and the gypsum board manufacturer's recommendations, where standards conflict the more stringent shall apply.
B. Install supplementary framing, blocking, backerplates and bracing at locations in gypsum board assemblies which are indicated to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer’s written recommendations or, if none available, with United States Gypsum’s "Gypsum Construction Handbook."

C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.

3.3 INSTALLING STEEL FRAMING

A. Install continuous runners (tracks) sized to match infill openings and structural walls and columns where gypsum board stud assemblies abut other construction. Secure runners to substrates with fasteners spaced a maximum of 8 inches on center unless closer spacing is recommended by the framing manufacturer. Provide fasteners at all corners and ends of runner tracks.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.

C. Extend framing full height of infill openings to existing framing supports or substrates. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief.
2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.

D. Install steel studs and furring in sizes and at spacing indicated but not less than that required by the referenced steel framing installation standard to comply with maximum deflection and minimum loading requirements specified, unless more stringent requirements are recommended by the gypsum board manufacturer:

1. Space studs 16 inches (400 mm) on center, unless otherwise indicated.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
3.4 CLEANING AND PROTECTION

A. Clean floors of all non-structural metal framing debris and leave broom clean. Excess material, scaffolding, tools and other equipment are to be removed upon completion of the Work.

B. Provide final protection and maintain conditions that ensure non-structural metal framing work remains without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 22 16
SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior gypsum board.

1.2 PRE-INSTALLATION MEETING

A. Prior to start of each type of gypsum board system, and at the Contractor's direction, meet at the site and review the installation procedures and coordination with other Work. Meeting shall include Contractor, Architect and major material manufacturer, as well as the Installer and other subcontractors whose Work must be coordinated with the gypsum board Work.

1.3 ACTION SUBMITTALS

A. Product Data for each product specified.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

B. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

C. Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.
1.6 FIELD CONDITIONS

A. Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Installation of gypsum board joint treatments shall not start until the space to receive gypsum board joint treatments is heated to maintain a continuous and uniform temperature of not less than 55 deg F (8 deg C), from one week prior to beginning of joint treatment until joint treatment is completed and thoroughly dry. Ventilation, either natural or supplied by fans, circulators or air conditioning systems shall be provided to remove excess moisture during joint treatment. Temperature requirements may be waived only on recommendation of gypsum board manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.


2.2 MATERIALS, GENERAL

A. General: For fire rated assemblies, provide materials, including accessories and fasteners produced by one manufacturer, or, when products of more than one manufacturer are used in a rated system, they shall be acceptable to authorities having jurisdiction.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Continental Building Products/Lafarge North America Inc.
6. PABCO Gypsum.
7. USG Corporation.

B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
C. Gypsum Board: ASTM C 1396/C 1396M.

1. Type X:
   a. Thickness: 5/8 inch (15.9 mm).
   b. Long Edges: Tapered.
   c. Location: Vertical surfaces, where required for fire-resistance-rated assembly, and where indicated on Drawings.

2.4 TRIM ACCESSORIES

A. Interior Steel Trim Accessories: ASTM C 1047; formed metal sheet steel zinc coated by hot-dipped process. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047.

1. Cornerbead: Use at outside corners.
2. LC-Bead with both face and back flanges to receive joint compound; use at exposed panel edges.
3. U-Bead with face and back flanges; face flange formed to be left without application of joint compound: Use where indicated.

2.5 JOINT TREATMENT MATERIALS

A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of the products and joint treatment materials for each application indicated.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, flanges of trim accessories, and fasteners, use setting-type taping compound.
3. Second Coat: For filling over tape, beads and fasteners. Use setting-type, sandable topping compound.
4. Third Coat: For finishing over tape, beads and fasteners. Use drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board assemblies attach or abut, installed door frames and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS

A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840, GA-216, and the gypsum board manufacturer’s recommendations, where standards conflict, the more stringent shall apply. Install specialty gypsum board as specified below except where manufacturer’s instructions conflict; follow manufacturer’s instructions for specialty performance board to maintain warranty coverage.

B. Single-Layer Application:
   1. On partitions/walls and infill of openings, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints or avoid them entirely.
      a. Stagger abutting end joints not less than one framing member in alternate courses of board.

C. Multilayer Application:
   1. On Partitions/Walls and infill of openings: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

D. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

E. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

F. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
G. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions.

H. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Attach gypsum panels to framing provided at openings and cutouts.

J. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Fit gypsum panels around ducts, pipes, and conduits.
   2. Where partitions intersect open exterior and interior wall kickers, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by the wall kickers and other structural members; allow 1/4 to 3/8 inch (6.4 to 9.5 mm) wide joints to install sealant.
   3. Where chase walls are shown, provide bracing between parallel rows of studs. Unless otherwise shown, provide gypsum board braces no less than 1/2 inch (12.7 mm) thick by 12 inches (300 mm) wide and cut to width of chase. Locate at quarter points in wall height between each pair of parallel studs. Fasten with not less than 3 screws at each stud.

K. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4 to 1/2 inch (6.4 to 12.7 mm) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

L. Cut openings in gypsum board for electrical outlets, piping and other penetrations. Maintain close tolerances so that edges will be covered by plates and escutcheons. Cut both face and back paper. Do not install electrical outlets back to back on opposing sides of partitions.

M. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
   1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
   2. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.
   3. Install fasteners not less than 3/8 inch (9.5 mm) from ends or edges of gypsum board sheets, spacing fasteners opposite each other on adjacent ends or edges.
   4. Begin fastening from center of gypsum board and proceed toward edges and corners.
   5. Apply pressure on surface of gypsum board adjacent to fasteners being driven to ensure that gypsum board will be secured tightly to supporting members.
      a. Drive fastener with shank perpendicular to face of board.
      b. Drive screws with a power screwdriver as recommended by gypsum board manufacturer. Set heads of screws slightly below surface of paper without cutting paper.
3.3 INSTALLING TRIM ACCESSORIES

A. General: Fasten trim accessories according to manufacturer's written instructions for type, length, and spacing of fasteners.

B. Install corner beads at external corners.

C. Install interior trim accessories where edge of gypsum panels would otherwise be exposed or semiexposed. Provide interior trim accessories with face flange formed to receive joint compound.

D. Install control joints in locations indicated and where directed by the Architect for visual effect, or if not indicated or directed by the Architect, provide control joints in accordance with ASTM C 840 which is as follows:

3.4 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Apply joint treatment at gypsum board joints, flanges of interior trim and aluminum trim accessories, interior angles, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated. Produce surfaces free of tool marks and ridges ready for decoration of type indicated. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

   1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
   2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
   3. Level 3: Typically not used.
   4. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.

3.5 CLEANING AND PROTECTION

A. Clean floors of all gypsum board debris and leave broom clean. Excess material, scaffolding, tools and other equipment are to be removed upon completion of the Work.
B. Provide final protection and maintain conditions that ensure gypsum board assemblies remain without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 29 00
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. Pipe, tube, and fittings.
   2. Specialty pipe fittings.
   3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS
A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Storm Drainage Piping: 10-foot head of water.
   2. Storm Drainage, Force-Main Piping: 100 psig.

1.4 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Field quality-control reports.

1.5 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 PROJECT CONDITIONS
A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Architect no fewer than five days in advance of proposed interruption of storm-drainage service.
   2. Do not proceed with interruption of storm-drainage service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS
A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service classes.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
   1. Pipe and fittings shall be produced and manufactured domestically. Pipe and fittings that are produced internationally may be considered for approval if approved in writing by the authorities having jurisdiction. If contractor wishes to submit on pipe and fittings that are produced internationally, contractor shall provide the written letter from the AHJ to the engineer as well as provide additional items that may be requested by the engineer.

B. CISPI, Hubless-Piping Couplings:
   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. MIFAB, Inc.
      b. Tyler Pipe.
   3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
   3. Unshielded, Nonpressure Transition Couplings:
      b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
      c. Sleeve Materials:
         2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
         3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
   4. Shielded, Nonpressure Transition Couplings:
b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5. Pressure Transition Couplings:
   b. Description: Metal, sleeve-type couplings same size as, with pressure rating at least equal to and ends compatible with, pipes to be joined.
   c. Center-Sleeve Material: Manufacturer's standard.
   d. Gasket Material: Natural or synthetic rubber.
   e. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2. Dielectric Unions:
   a. Description:
      1) Standard: ASSE 1079.
      2) Pressure Rating: 150 psig at 180 deg F.
      3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:
   a. Description:
      1) Standard: ASSE 1079.
      2) Factory-fabricated, bolted, companion-flange assembly.
      3) Pressure Rating: 150 psig minimum.
      4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:
   a. Description:
      1) Nonconducting materials for field assembly of companion flanges.
      2) Pressure Rating: 150 psig.
      3) Gasket: Neoprene or phenolic.
      4) Bolt Sleeves: Phenolic or polyethylene.

5. Dielectric Nipples:
   a. Description:
      1) Electroplated steel nipple complying with ASTM F 1545.
      2) Pressure Rating: 300 psig at 225 deg F.
      3) End Connections: Male threaded or grooved.
      4) Lining: Inert and noncorrosive, propylene.
PART 3 - EXECUTION

3.1 EARTH MOVING
A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION
A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 1/4 inch per foot downward in direction of flow.
2. Horizontal Storm-Drainage Piping: 1/4 inch per foot downward in direction of flow.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

N. Install steel piping according to applicable plumbing code.

O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
P. Install aboveground ABS piping according to ASTM D 2661.
Q. Install aboveground PVC piping according to ASTM D 2665.
R. Install underground PVC piping according to ASTM D 2321.
S. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
T. Install force mains at elevations indicated.

U. Plumbing Specialties:
   1. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Division 22 Section "Storm Drainage Piping Specialties."
   2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Storm Drainage Piping Specialties."
   3. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Storm Drainage Piping Specialties."

V. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION


D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
E. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

F. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

G. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

H. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in OD's.
   2. In Drainage Piping: nonpressure transition couplings.
   4. In Underground Force-Main Piping:
      a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
      b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:
   1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
   2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
   3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits, or nipples.
   4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.
   1. Install gate or full-port ball valve for piping NPS 2 and smaller.
   2. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.
   1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
   2. Install backwater valves in accessible locations.
3. Comply with requirements for backwater valves specified in Division 22 Section "Storm Drainage Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.
I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.
   4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
   5. NPS 6: 10 feet with 5/8-inch rod.
   6. NPS 8: 10 feet with 3/4-inch rod.

J. Install supports for vertical copper tubing every 10 feet.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.
   1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
   2. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
   3. Comply with requirements for backwater valves, cleanouts, and, drains specified in Division 22 Section "Storm Drainage Piping Specialties."

D. Connect force-main piping to the following:
   1. Sump Pumps: To sump pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.10 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 15 and smaller shall be the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

C. Underground storm drainage piping NPS 15 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Aboveground storm drainage force mains NPS 1-1/2 and NPS 2 shall be any of the following:

1. Hard copper tube, copper pressure fittings, and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.

E. Aboveground storm drainage force mains NPS 2-1/2 to NPS 6 shall be any of the following:

1. Hard copper tube, copper pressure fittings, and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.
3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
4. Fitting-type transition couplings if dissimilar pipe materials.

END OF SECTION
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 requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Division 01 Section "Submittal Procedures" for coordinating Division 22 submittals with other Divisions.
2. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
3. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Division 01 Section "Demonstration and Training" for demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's and Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.


1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making
corrections or revisions to submittals noted by Architect and Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor’s construction schedule.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Engineer’s Digital Data Files: Electronic digital data files used to produce the Contract Drawings will be provided by Engineer for Contractor’s use in preparing submittals only after Engineer’s Release Form has been appropriately executed.

1. Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.

   a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

   b. Digital Drawing Software Program: The Contract Drawings are available in Autodesk AutoCAD and Autodesk Revit formats.

   c. Contractor shall execute a data licensing agreement (Engineer’s Release Form) in substantial agreement with AIA Document C106, Digital Data Licensing Agreement.

   d. The Contractor agrees as a pre-condition of the use of Engineer’s digital data files to provide Engineer with Contractor’s final files (Record Drawings) at the completion of the project in the same software version and with same electronic properties (layers, families, etc.) as provided by Engineer.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

   2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

   3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

   4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

      a. Architect and Engineer reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer’s receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

   1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer and Architect will advise Contractor when a submittal being processed must be delayed for coordination.

   2. Resubmittal Review: One resubmittal is allowed. Additional resubmittal reviews will be performed after Engineer’s review fees have been negotiated. Allow 15 days for review of each resubmittal.
D. Paper Submittals: Paper submittals will not be allowed.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

2. Name file with submittal number or other unique identifier, including revision identifier.
   a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and Engineer.

4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Engineer and Architect, containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.
   n. Related physical samples submitted directly.
   o. Indication of full or partial submittal.
   p. Transmittal number, numbered consecutively.
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

F. Options: Identify options requiring selection by Architect.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract
Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked with approval notation from Architect's and Engineer's action stamp.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Engineer's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   1. Submit electronic submittals as PDF electronic files via email or directly to Project Web site.
   2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
      a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to show which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's catalog cuts.
      b. Manufacturer's product specifications.
      c. Standard color charts.
      d. Statement of compliance with specified referenced standards.
      e. Testing by recognized testing agency.
      f. Application of testing agency labels and seals.
      g. Notation of coordination requirements.
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h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Schedules.
      c. Compliance with specified standards.
      d. Notation of coordination requirements.
      e. Notation of dimensions established by field measurement.
      f. Relationship and attachment to adjoining construction clearly indicated.
      g. Seal and signature of professional engineer if specified.
   2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
   3. Submit Shop Drawings in the following format:
      a. PDF electronic file.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.
   5. Submit product schedule in the following format:
      a. PDF electronic file.

E. Coordination Drawing Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

F. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."

G. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

H. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.
I. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

J. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

K. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

L. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

M. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

N. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

O. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

P. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

Q. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

R. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

S. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Engineer.

B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. Engineer's Review
   a. No Exceptions Taken: Engineer's review found no apparent discrepancies between submittal data and requirements of Contract Documents. No further submittal review action required from Contractor.
   b. Accepted as Noted: Engineer's review found the submittal to be in substantial conformance with the requirements of Contract Documents.
   c. Rejected: Engineer's review found the submittal to be in non-conformance with the requirements of Contract Documents.

2. Responses required by Contractor:
   a. Confirm: Contractor will review Engineer's notations on submittal and confirm via written response the information requested by Engineer
   b. Revise: Contractor will review Engineer's notations on submittal and revise submittal to comply.
   c. Resubmit: Contractor will make changes to submittal in accordance with Engineer's notations and resubmit.

3. Additional Requirements:
   a. Requires Review and Approval by _____: In addition to Engineer's review of submittal, the submittal must be officially submitted and approved by the authority noted.

B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Engineer.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Sleeves.
      2. Stack-sleeve fittings.
      3. Sleeve-seal systems.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES
   A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
   B. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS
   A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
      2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
   B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
      1. Underdeck Clamp: Clamping ring with setscrews.
2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."
3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
   2. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
   3. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   4. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs above grade.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade:
      a. Piping Smaller Than NPS 8: Galvanized-steel-pipe sleeves.
   2. Concrete Slabs above Grade:
      a. Piping Smaller Than NPS 8: PVC-pipe sleeves, Molded-PE or -PP sleeves, or Molded-PVC sleeves.
   3. Interior Partitions:
      a. Piping Smaller Than NPS 8: Galvanized-steel-pipe sleeves.

END OF SECTION
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 pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Fastener systems.
   5. Equipment supports.
B. Related Sections:
   1. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS
A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS
A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

1.6 INFORMATIONAL SUBMITTALS
A. Welding certificates.
1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carpenter & Paterson, Inc.
   3. ERICO International Corporation.
   5. PHS Industries, Inc.
   6. Pipe Shields Inc.
   7. Piping Technology & Products, Inc.
   8. Rilco Manufacturing Co., Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-uninsulated minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psi minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 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 a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
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J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel l-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel l-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel l-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes the following:
   1. Isolation pads.
   2. Isolation mounts.
   3. Elastomeric hangers.
   4. Spring hangers.

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS
A. Product Data: For the following:
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

1.5 INFORMATIONAL SUBMITTALS
A. Welding certificates.
   B. Field quality-control test reports.

1.6 QUALITY ASSURANCE
A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
4. Isolation Technology, Inc.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene or rubber.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
F. **Elastomeric Hangers:** Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

G. **Spring Hangers:** Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
   1. **Frame:** Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. **Outside Spring Diameter:** Not less than 80 percent of the compressed height of the spring at rated load.
   3. **Minimum Additional Travel:** 50 percent of the required deflection at rated load.
   4. **Lateral Stiffness:** More than 80 percent of rated vertical stiffness.
   5. **Overload Capacity:** Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. **Elastomeric Element:** Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   7. **Self-centering hanger rod cap** to ensure concentricity between hanger rod and support spring coil.

### 2.2 FACTORY FINISHES

A. **Finish:** Manufacturer’s standard paint applied to factory-assembled and -tested equipment before shipping.
   1. Powder coating on springs and housings.
   2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
   3. Baked enamel or powder coat for metal components on isolators for interior use.
   4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLICATIONS

A. **Strength of Support Assemblies:** Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.
3.3 VIBRATION-CONTROL DEVICE INSTALLATION

A. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

B. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to Owner.
   2. Measure isolator restraint clearance.
   3. Measure isolator deflection.
   4. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.
3.6 HVAC VIBRATION-CONTROL DEVICE SCHEDULE

A. Suspended Equipment: Fan Powered VAV Boxes.
   1. Isolator Type: Spring Hanger.
   2. Base Type: No base, isolator attached directly to unit.
   3. Minimum Deflection: 0.75"

B. Suspended Equipment: VAV Boxes.
   1. Isolator Type: Elastomeric Hanger.
   2. Base Type: No base, isolator attached directly to unit.
   3. Minimum Deflection: 0.75"

C. Supported or Suspended Equipment: Pump.
   1. Isolator Type: Spring Hanger.
   2. Base Type: No base, isolator attached directly to unit.
   3. Minimum Deflection: 1.50"

D. Equipment: Chilled Water Air Handler.
   1. Isolator Type: Isolator Pad.
   2. Base Type: No base, isolator attached directly to unit.
   3. Minimum Deflection: 0.75"

E. Supported or Suspended Equipment: Hot Water Pipe.
   1. Isolator Type: Elastomeric Hanger.
   2. Base Type: No base, isolator attached directly to unit.
   3. Minimum Deflection: 0.75"

F. Supported or Suspended Equipment: Chilled Water Pipe.
   1. Isolator Type: Elastomeric Hanger.
   2. Base Type: No base, isolator attached directly to unit.
   3. Minimum Deflection: 0.75"

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Duct labels.
   5. Stencils.
   6. Valve tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.


C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.
2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Blue.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.5 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on the following equipment:

1. Air Handling Units
2. Boilers
3. Building Automation System Control Panels
4. Pumps
5. Fans
6. Terminal Units
7. Variable Frequency Drives
8. Miscellaneous Equipment

B. Locate equipment labels where accessible and visible.

C. Equipment Label Content Schedule. Include the following information on equipment labels.

1. Radiant Heater:
   a. Drawing Designation (e.g. RH 1A-1).
   b. Design Total Cooling Capacity (MBH).
   c. Design Sensible Cooling Capacity (MBH).
   d. Design Airflow (CFM).
e. Fan Power (HP).
f. Design Chilled Water Flow (GPM).
g. Design Coil Pressure Drop (FT. HD).
h. Volts/Ph/Hz.
i. Electrical Panel/Circuit Number(s) served by.

2. Pumps:
a. Drawing Designation (e.g. HWP 5-1).
b. Design Flow Rate (GPM).
c. Design Total Head (FT).
d. Motor Horsepower.
e. Volts/Ph/Hz.
f. Electrical Panel/Circuit Number(s) served by.

3. Variable Air Volume:
a. Drawing Designation (e.g. VAV D-1).
b. Design Airflow (CFM).
c. External Static Pressure (in. w.g.).
d. Fan Power (HP).
e. Electrical Panel/Circuit Number(s) served by.

4. Fan Powered Terminal Units:
a. Drawing Designation (e.g. FPB 5-1).
b. Design Airflow (CFM).
c. Design Hot Water Flow (GPM).
d. Design Heating Capacity (KW).
e. Air Handling Unit served by.
f. Electrical Panel/Circuit Number(s) served by.

5. Variable Frequency Drives:
a. Drawing Designation (e.g. VFD 5-1).
b. Equipment Served (e.g. HWP 5-1).
c. Motor Horsepower.
d. Volts/Ph/Hz.
e. Electrical Panel/Circuit Number(s) served by.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
   b. Hot Water: 2 inches, round.

2. Valve-Tag Color:
   b. Hot Water: Natural.

3. Letter Color:
   b. Hot Water: Yellow.
3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION
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 testing, adjusting, balancing, and commissioning HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly and perform their intended functions.
6. Calibrating automatic temperature control sensors.
7. Reporting results of the activities and procedures specified in this Section.

B. Related Sections include the following:

1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. System Commissioning: The process for achieving, verifying, and documenting the performance of that system to meet the operational needs of the building within the capabilities of the design and to meet the design documentation and the owner’s functional criteria, including preparation of the operator personnel.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

F. Report Forms: Test data sheets for recording test data in logical order.
G. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

H. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

I. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

J. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

K. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

L. Test: A procedure to determine quantitative performance of a system or equipment.

M. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, balancing, and commissioning procedures.


P. ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers

Q. CTI: Cooling Tower Institute.


S. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.


D. Sample report forms.

E. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.
F. Construction Progress Reports: Provide construction progress reports at 25% and 75% construction completion.

G. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

H. Commissioning Documents: Submit 2 copies of the completed commissioning documents, including Pre-functional and Functional system test documents and Building Automation System Points verification sheets.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB or TABB.

2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.

B. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.

2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

C. Testing, Adjusting, and Balancing Reports: Use testing, adjusting, and balancing Agent's standard forms approved by the Engineer.

D. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification," or as described in AABC national standards.

E. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
1.7 COORDINATION

A. Notice: Provide seven days’ advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, balancing, and commissioning of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.

2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine project record documents described in Division 1 Section "Project Record Documents."

D. Examine Engineer's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

G. Examine system and equipment test reports.
H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

R. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record set points and calibration method(s).
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.

S. Report deficiencies discovered before and during performance of testing, adjusting, balancing, and commissioning procedures.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.
B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in this section and either, AABC national standards, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 15 Section "Duct Insulation," Division 15 Section "HVAC Equipment Insulation," and Division 15 Section "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.
H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 15815 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
   a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:
   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

   a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   
a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.

8. Record final fan-performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

   1. Open all manual valves for maximum flow.
   2. Check liquid level in expansion tank.
   3. Check makeup water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
   5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   6. Set system controls so automatic valves are wide open to heat exchangers.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.9 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

   1. Manufacturer's name, model number, and serial number.
   4. Efficiency rating.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter thermal-protection-element rating.
B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.10 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:
   1. Entering- and leaving-water temperature.
   2. Water flow rate.
   3. Water pressure drop.
   4. Dry-bulb temperature of entering and leaving air.
   5. Wet-bulb temperature of entering and leaving air for cooling coils.
   6. Airflow.
   7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperature at full load.
   4. Voltage and amperage input of each phase at full load and at each incremental stage.
   5. Calculated kilowatt at full load.
   6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:
   1. Dry-bulb temperature of entering and leaving air.
   2. Airflow.
   3. Air pressure drop.
   4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:
   1. Dry-bulb temperature of entering and leaving air.
   2. Wet-bulb temperature of entering and leaving air.
   3. Airflow.
   4. Air pressure drop.
   5. Refrigerant suction pressure and temperature.

3.11 TEMPERATURE-CONTROL VERIFICATION

A. Verify that each point on the “Points List” exists, is terminated properly, is functioning properly, and is calibrated.

B. Verify that controllers are calibrated and commissioned.

C. Check transmitter and controller locations and note conditions that would adversely affect control functions.

D. Record controller settings and note variances between set points and actual measurements.
E. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

F. Verify free travel and proper operation of control devices such as damper and valve operators.

G. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

H. Confirm interaction of electrically operated switch transducers.

I. Confirm interaction of interlock and lockout systems.

J. Verify main control supply-air pressure and observe compressor and dryer operations.

K. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.

L. Note operation of electric actuators using spring return for proper fail-safe operations.

3.12 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
2. Air Outlets and Inlets for Constant Volume Systems: Plus or minus 5 percent.
3. Air Outlets and Inlets for Variable Volume Systems: Plus or minus 10 percent.
4. Water flow rate through pumps, chillers, and hydronic coils: Plus or minus 5 percent.

3.13 REPORTING

A. Construction Progress Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested, balanced, and commissioned.

B. Commissioning Plan: As Work progresses, modify the preliminary commissioning plan as required to include necessary changes.

C. Final Commissioning Documents: Assemble Pre-functional test forms, final functional test forms, warranties, Point List Verification, Final Test and Balance Report, and other reports outlined in the referenced standards in binder(s) suitably labeled and indexed.

3.14 FINAL TEST AND BALANCE REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
2. Fan curves.
3. Manufacturers’ test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect’s name and address.
6. Engineer’s name and address.
7. Contractor’s name and address.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
   a. Indicated versus final performance.
   b. Notable characteristics of systems.
   c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer’s name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
   a. Settings for outdoor-, return-, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Face and bypass damper settings at coils.
   e. Fan drive settings including settings and percentage of maximum pitch diameter.
   f. Inlet vane settings for variable-air-volume systems.
   g. Settings for supply-air, static-pressure controller.
   h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
1. Unit identification.
2. Location.
3. Make and type.
4. Model number and unit size.
5. Manufacturer's serial number.
6. Unit arrangement and class.
7. Discharge arrangement.
8. Sheave make, size in inches, and bore.
9. Center-to-center dimensions of sheave, and amount of adjustments in inches.
10. Number, make, and size of belts.
11. Number, type, and size of filters.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
   a. Total air flow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Heating-coil static-pressure differential in inches wg.
   i. Outdoor airflow in cfm.
   j. Return airflow in cfm.
   k. Outdoor-air damper position.
   l. Return-air damper position.

F. Packaged Chiller Reports: For each chiller, include the following:

1. Unit Data: Include the following:
   a. Unit identification.
   b. Make and model number.
   c. Manufacturer's serial number.
   d. Refrigerant type and capacity in gal.
   e. Starter type and size.
   f. Starter thermal protection size.

2. Evaporator Test Reports: Include design and actual values for the following:
   a. Refrigerant pressure in psig.
   b. Refrigerant temperature in deg F.
   c. Entering-water temperature in deg F.
   d. Leaving-water temperature in deg F.
   e. Entering-water pressure in feet of head or psig.
   f. Water pressure differential in feet of head or psig.
3. Compressor Test Data: Include design and actual values for the following:
   a. Make and model number.
   b. Manufacturer's serial number.
   c. Suction pressure in psig.
   d. Suction temperature in deg F.
   e. Discharge pressure in psig.
   f. Discharge temperature in deg F.
   g. Oil pressure in psig.
   h. Oil temperature in deg F.
   i. Voltage at each connection.
   j. Amperage for each phase.
   k. The kW input.
   l. Crankcase heater kW.
   m. Chilled water control set point in deg F.
   n. Condenser water control set point in deg F.
   o. Refrigerant low-pressure-cutoff set point in psig.
   p. Refrigerant high-pressure-cutoff set point in psig.

G. Electric-Coil Test Reports: For electric furnaces and electric coils installed in central-station air-handling units and ducts, include the following:

1. Unit Data:
   a. System identification.
   b. Location.
   c. Coil identification.
   d. Capacity in Btu/h.
   e. Number of stages.
   f. Connected volts, phase, and hertz.
   g. Rated amperage.
   h. Air flow rate in cfm.
   i. Face area in sq. ft.
   j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):
   a. Heat output in Btu/h.
   b. Air flow rate in cfm.
   c. Air velocity in fpm.
   d. Entering-air temperature in deg F.
   e. Leaving-air temperature in deg F.
   f. Voltage at each connection.
   g. Amperage for each phase.

H. Water Coil Test Reports: For water coils installed in central-station air-handling units and ducts, include the following:

1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
   1. Fan Data:
      a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

   2. Motor Data:
      a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

   3. Test Data (Indicated and Actual Values):
      a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
   1. Report Data:
a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:

1. Unit Data:

   a. System and air-handling unit identification.
   b. Location and zone.
   c. Apparatus used for test.
   d. Area served.
   e. Make.
   f. Number from system diagram.
   g. Type and model number.
   h. Size.
   i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

   a. Air flow rate in cfm.
   b. Air velocity in fpm.
   c. Preliminary air flow rate as needed in cfm.
   d. Preliminary velocity as needed in fpm.
   e. Final air flow rate in cfm.
   f. Final velocity in fpm.
   g. Space temperature in deg F.

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and size.
   e. Model number and serial number.
   f. Water flow rate in gpm.
   g. Water pressure differential in feet of head or psig.
   h. Required net positive suction head in feet of head or psig.
   i. Pump rpm.
   j. Impeller diameter in inches.
   k. Motor make and frame size.
   l. Motor horsepower and rpm.
   m. Voltage at each connection.
   n. Amperage for each phase.
   o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.
   d. Full-open flow rate in gpm.
   e. Full-open pressure in feet of head or psig.
   f. Final discharge pressure in feet of head or psig.
   g. Final suction pressure in feet of head or psig.
   h. Final total pressure in feet of head or psig.
   i. Final water flow rate in gpm.
   j. Voltage at each connection.
   k. Amperage for each phase.

M. Instrument Calibration Reports:
   1. Report Data:
      a. Instrument type and make.
      b. Serial number.
      c. Application.
      d. Dates of use.
      e. Dates of calibration.

3.15 INSPECTIONS

A. Initial Inspection:
   1. After testing and balancing are complete, operate each system and randomly check
      measurements to verify that the system is operating according to the final test and
      balance readings documented in the final report.
   2. Check the following for each system:
      a. Measure airflow of at least 10 percent of air outlets.
      b. Measure water flow of at least 10 Insert number percent of terminals.
      c. Measure room temperature at each thermostat/temperature sensor. Compare the
         reading to the set point.
      d. Verify that balancing devices are marked with final balance position.
      e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:
   1. After initial inspection is complete and documentation by random checks verifies that
      testing and balancing are complete and accurately documented in the final report,
      request that a final inspection be made by Construction Manager.
   2. The TAB contractor's test and balance engineer shall conduct the inspection in the
      presence of Construction Manager.
   3. Construction Manager shall randomly select measurements, documented in the final
      report, to be rechecked. Rechecking shall be limited to either 10 percent of the total
measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.16 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION
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 insulating the following duct services:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in unconditioned space.
B. Related Sections:
   1. Division 23 Section "HVAC Piping Insulation."
   2. Division 23 Section "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
   3. Detail application of field-applied jackets.
   4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS
A. Qualification Data: For qualified Installer.
B. Field quality-control reports.

1.5 QUALITY ASSURANCE
A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having
jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields.
B. Coordinate clearance requirements with duct installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," articles for where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed Corp.; Commercial Board.
   b. Fibrex Insulations Inc.; FBX.
   c. Johns Manville; 800 Series Spin-Glas.
   d. Knauf Insulation; Insulation Board.
   e. Manson Insulation Inc.; AK Board.
   f. Owens Corning; Fiberglas 700 Series.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated. Comply with Specification Section 01 35 46 – IAQ Management.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide products by one of the following:
   b. Eagle Bridges - Marathon Industries; 225.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).


1. Products: Subject to compliance with requirements, provide products by one of the following:
   b. Eagle Bridges - Marathon Industries; 225.
   d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II and with Specification Section 01 35 46 – IAQ Management.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide products by one of the following:
   b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.


2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates. Comply with Specification Section 01 35 46 – IAQ Management.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, provide products by one of the following:
   c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.

4. Service Temperature Range: 0 to plus 180 deg F.


2.5 SEALANTS

A. FSK Jacket Flashing Sealants: Comply with Specification Section 01 35 46 – IAQ Management.
1. Products: Subject to compliance with requirements, provide products by one of the following:
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.

5. Color: Aluminum.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants:

1. Products: Subject to compliance with requirements, provide products by one of the following:

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.


6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide products by one of the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide products by one of the following:
   a. ABI, Ideal Tape Division; 491 AWF FSK.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide products by one of the following:
   a. ABI, Ideal Tape Division; 488 AWF.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   c. Compac Corporation; 120.
   d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide products by one of the following:
   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. Childers Products; Bands.
   c. PABCO Metals Corporation; Bands.
   d. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Insulation Pins and Hangers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   a. Products: Subject to compliance with requirements, provide products by one of the following:
      1) AGM Industries, Inc.; CHP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.

2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide products by one of the following:
      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.
   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum or Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products: Subject to compliance with requirements, provide products by one of the following:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
2.9 CORNER ANGLES
   A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to
      ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine substrates and conditions for compliance with requirements for installation tolerances
      and other conditions affecting performance of insulation application.
      1. Verify that systems to be insulated have been tested and are free of defects.
      2. Verify that surfaces to be insulated are clean and dry.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
   A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will
      adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS
   A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces;
      free of voids throughout the length of ducts and fittings.
   B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for
      each item of duct system as specified in insulation system schedules.
   C. Install accessories compatible with insulation materials and suitable for the service. Install
      accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or
      dry state.
   D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
   E. Install multiple layers of insulation with longitudinal and end seams staggered.
   F. Keep insulation materials dry during application and finishing.
   G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with
      adhesive recommended by insulation material manufacturer.
   H. Install insulation with least number of joints practical.
   I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers,
      supports, anchors, and other projections with vapor-barrier mastic.
      1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be
limited to three locations for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Medium pressure supply air ducts.
   2. Indoor, return air ductwork located in unconditioned space.
   3. Outdoor, exhaust air ducts.

B. Items Not Insulated:
   1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   2. Factory-insulated flexible ducts.
   3. Factory-insulated plenums and casings.
   4. Flexible connectors.
   5. Vibration-control devices.
   6. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed and exposed, round supply-, return, and outside-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed and exposed, rectangular, supply-, return- and outside-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

END OF SECTION
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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 insulating the following HVAC piping systems:
   1. Condensate drain piping, indoors and outdoors.
   2. Chilled-water, indoors and outdoors.

B. Related Sections:
   1. Division 23 Section "Duct Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

   1. Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in “Piping Insulation Schedule, General,” “Indoor Piping Insulation Schedule,” and “Outdoor, Aboveground Piping Insulation Schedule” articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Aeroflex USA, Inc.; Aerocel.
   b. Armacell LLC; AP Armaflex.
   c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Johns Manville; Micro-Lok.
   b. Knauf Insulation; 1000-Degree Pipe Insulation.
   c. Manson Insulation Inc.; Alley-K.
   d. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Mineral-Fiber, Pipe Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Manson Insulation Inc.; AK Flex.
   e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS


C. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

D. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

E. Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

F. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

G. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.


I. PVC Jacket Adhesive: Compatible with PVC jacket.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:
a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges - Marathon Industries; 225.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
2. Service Temperature Range: 0 to plus 180 deg F.
2.6 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:

   a. Factory cut and rolled to size.
   b. Thickness are indicated in piping insulation schedules.
   c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
9) Color - White

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.10 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through-wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:
HVAC PIPING INSULATION
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1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION
A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FINISHES
A. Flexible Elastomeric Thermal Insulation: After the adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
B. Do not field paint aluminum or stainless-steel jackets.

3.10 PIPING INSULATION SCHEDULE, GENERAL
A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground condensate piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE
A. Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 3/4 inch thick.
   2. Field Applied Jacket: None.
B. Chilled-Water Supply and Return:
   1. Insulation shall be the following:
      a. NPS 4 and Smaller: Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.
      b. NPS 6 to 12: Mineral-Fiber, Preformed Pipe, Type I: 2 inch thick.
3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1/2 inch thick.
   2. Field Applied Jacket: None.

B. Chilled-Water Supply and Return:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 3 inches thick.
   2. Field Applied Jacket: Aluminum, Smooth, 0.016 inch thick, White in color.
   3. Where piping is subject to foot traffic, place a rigid insert on top of the pipe of 2 inch thick calcium silicate.

END OF SECTION
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 control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Related Sections include the following:
   1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
   2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. MS/TP: Master slave/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:
   1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
   2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
   3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
   4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
   5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
   6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
   7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

a. Water Temperature: Plus or minus 1 deg F.
b. Water Flow: Plus or minus 5 percent of full scale.
c. Water Pressure: Plus or minus 2 percent of full scale.
d. Space Temperature: Plus or minus 1 deg F.
e. Ducted Air Temperature: Plus or minus 1 deg F.
f. Outside Air Temperature: Plus or minus 2 deg F.
g. Dew Point Temperature: Plus or minus 3 deg F.
h. Temperature Differential: Plus or minus 0.25 deg F.
i. Relative Humidity: Plus or minus 5 percent.
j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
l. Airflow (Terminal): Plus or minus 10 percent of full scale.
m. Air Pressure (Space): Plus or minus 0.01-inch wg.
n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
o. Carbon Dioxide: Plus or minus 50 ppm.
p. Electrical: Plus or minus 5 percent of reading.

1.5 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.

2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.

3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Schedule of dampers including size, leakage, and flow characteristics.
6. Schedule of valves including flow characteristics.
7. DDC System Hardware:

   a. Wiring diagrams for control units with termination numbers.
   b. Schematic diagrams and floor plans for field sensors and control hardware.
   c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
8. **Control System Software:** List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.

9. **Controlled Systems:**
   a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
   b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
   c. Written description of sequence of operation including schematic diagram.
   d. Points list.

### 1.6 INFORMATIONAL SUBMITTALS

A. **Data Communications Protocol Certificates:** Certify that each proposed DDC system component complies with ASHRAE 135.

B. **Data Communications Protocol Certificates:** Certify that each proposed DDC system component complies with LonWorks.

C. **Software Upgrade Kit:** For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

D. Field quality-control test reports.

### 1.7 CLOSEOUT SUBMITTALS

A. **Operation and Maintenance Data:** For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

B. **Software and Firmware Operational Documentation:** Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

### 1.8 QUALITY ASSURANCE

A. **Installer Qualifications:** Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ASHRAE 135 for DDC system components.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.10 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 28 Section "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with building master clock.

C. Coordinate equipment with Division 28 Section "Access Control" to achieve compatibility with equipment that interfaces with that system.

D. Coordinate equipment with Division 27 Section "Clock Systems" to achieve compatibility with equipment that interfaces with that system.

E. Coordinate equipment with Division 28 Section "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.

F. Coordinate equipment with Division 26 Section "Network Lighting Controls" to achieve compatibility with equipment that interfaces with that system.

G. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.

H. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

I. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

J. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

K. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

L. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
PART 2 - PRODUCTS

2.1 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:
   1. Available Manufacturers:
      a. BEC Controls Corporation.
      b. Ebtron, Inc.
      c. Heat-Timer Corporation.
      d. I.T.M. Instruments Inc.
      e. MAMAC Systems, Inc.
      f. RDF Corporation.
   2. Accuracy: Plus or minus 0.5 deg F at calibration point.
   4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
   5. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
   6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
   7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
   8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

C. RTDs and Transmitters:
   1. Available Manufacturers:
      a. BEC Controls Corporation.
      b. MAMAC Systems, Inc.
      c. RDF Corporation.
   2. Accuracy: Plus or minus 0.2 percent at calibration point.
   4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
   5. Averaging Elements in Ducts: 24 feet long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
   6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
   7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
   8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

D. Pressure Transmitters/Transducers:
   1. Available Manufacturers:
a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
   a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
   b. Output: 4 to 20 mA.
   c. Building Static-Pressure Range: 0- to 0.25-inch wg.
   d. Duct Static-Pressure Range: 0- to 5-inch wg.

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.2 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
2.3 GAS DETECTION EQUIPMENT

A. Available Manufacturers:

1. B. W. Technologies.
2. CEA Instruments, Inc.
3. Ebtron, Inc.
4. Gems Sensors Inc.
5. Greystone Energy Systems Inc.
7. INTEC Controls, Inc.
8. I.T.M. Instruments Inc.
9. MSA Canada Inc.
10. QEL/Quatrosense Environmental Limited.
11. Sauter Controls Corporation.
12. Sensidyne, Inc.
13. TSI Incorporated.
15. Vulcain Inc.

B. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.

2.4 OCCUPANCY SENSORS

A. Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

2.5 FLOW MEASURING STATIONS

A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.

1. Available Manufacturers:
   a. Air Monitor Corporation.
   b. Wetmaster Co., Ltd.

2. Casing: Galvanized-steel frame.

3. The Outside Airflow Measurement System shall contain an integral multi-line liquid crystal display for use during the configuration and calibration processes, and to display two measured processes (volume, velocity, temperature) during normal operation. All configuration, output scaling, calibration, and controller tuning will be performed digitally in the on-board microprocessor via input pushbuttons.

4. The Outside Airflow Measurement System shall measure inlet airflow with an accuracy of ±5% of reading over a range of 150-600 FPM, 250-1,000 FPM, 150-2,000 FPM, and 500-2,000 FPM and not have its reading affected by the presence of directional or gusting wind. Measured airflow shall be density corrected for ambient temperature variances, and atmospheric pressure due to site altitude.

5. The Outside Airflow Measurement System shall interface with existing building automation systems (BAS).
6. The sensors shall be constructed of materials that resist corrosion due to the presence of salt or chemicals in the air; all non-painted surfaces shall be constructed of stainless steel. Sensors shall be factory mounted in an airflow station constructed of 14 ga. [18 ga. for circular units] galvanized steel, 6" deep welding casing with 90º connecting flanges and a galvanized expanded metal sheet. The electronics enclosure shall be NEMA 1.

2.6 THERMOSTATS

A. Available Manufacturers:

1. Erie Controls.
4. Sauter Controls Corporation.
5. tekmar Control Systems, Inc.
6. Theben AG - Lumilite Control Technology, Inc.

B. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:

   a. Time of day.
   b. Actual room temperature.
   c. Programmed temperature.
   d. Programmed time.
   e. Duration of timed override.
   f. Day of week.
   g. System mode indications include "heating," "off," "fan auto," and "fan on."

C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

D. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.

E. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.
3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

F. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

G. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

H. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
   2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

I. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
   2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

J. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

2.7 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
   1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
   3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
   5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
B. **Electronic Actuators:** Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. **Available Manufacturers:**
   - Belimo Aircontrols (USA), Inc.

2. **Valves:** Size for torque required for valve close off at maximum pump differential pressure.

3. **Dampers:** Size for running torque calculated as follows:
   - **Parallel-Blade Damper with Edge Seals:** 7 inch-lb/sq. ft. of damper.
   - **Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm:** Increase running torque by 1.5.

4. **Coupling:** V-bolt and V-shaped, toothed cradle.

5. **Overload Protection:** Electronic overload or digital rotation-sensing circuitry.

6. **Fail-Safe Operation:** Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.

7. **Power Requirements (Two-Position Spring Return):** 24-V ac.

8. **Power Requirements (Modulating):** Maximum 10 VA at 24-V ac or 8 W at 24-V dc.

9. **Proportional Signal:** 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.

10. **Temperature Rating:** Minus 22 to plus 122 deg F.

11. **Temperature Rating (Smoke Dampers):** Minus 22 to plus 250 deg F.

12. **Run Time:** 12 seconds open, 5 seconds closed.

### 2.8 CONTROL VALVES

**A. Available Manufacturers:**

2. Erie Controls.
3. Hayward Industrial Products, Inc.
5. Neles-Jamesbury.
6. Parker Hannifin Corporation; Skinner Valve Division.
7. Pneuline Controls.
8. Sauter Controls Corporation.

**B. Control Valves:** Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

**C. Hydronic system globe valves shall have the following characteristics:**

1. **NPS 2 and Smaller:** Class 250 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. **NPS 2-1/2 and Larger:** Class 250 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. **Internal Construction:** Replaceable plugs and stainless-steel or brass seats.
   - **Double-Seated Valves:** Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
4. **Sizing:** 5-psig maximum pressure drop at design flow rate or the following:
b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.

5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 300 for service at 300 psig and 250 deg F operating conditions.
2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.9 DAMPERS

A. Available Manufacturers:

1. Air Balance Inc.
2. Don Park Inc.; Autodamp Div.
3. TAMCO (T. A. Morrison & Co. Inc.).
4. United Enertech Corp.
5. Vent Products Company, Inc.

B. Dampers: AMCA-rated, parallel-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

2.10 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
   1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install guards on thermostats in the following locations:
   1. Entrances.
   2. Public areas.
   3. Where indicated.

E. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

H. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

I. Install steam and condensate instrument wells, valves, and other accessories according to Division 23 Section "Steam and Condensate Heating Piping."

J. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."

K. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

L. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
   1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
   2. Install exposed cable in raceway.
   3. Install concealed cable in raceway.
   4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
   5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.

2. Test and adjust controls and safeties.

3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

4. Test each point through its full operating range to verify that safety and operating control set points are as required.

5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.

6. Test each system for compliance with sequence of operation.

7. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.

2. Check instruments for proper location and accessibility.

3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.

4. Check instrument tubing for proper fittings, slope, material, and support.

5. Check installation of air supply for each instrument.

6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.

7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.

8. Check temperature instruments and material and length of sensing elements.

9. Check control valves. Verify that they are in correct direction.

10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.

11. Check DDC system as follows:

   a. Verify that DDC controller power supply is from emergency power supply, if applicable.

   b. Verify that wires at control panels are tagged with their service designation and approved tagging system.

   c. Verify that spare I/O capacity has been provided.

   d. Verify that DDC controllers are protected from power supply surges.
D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
   a. Check analog inputs at 0, 50, and 100 percent of span.
   b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
   c. Check digital inputs using jumper wire.
   d. Check digital outputs using ohmmeter to test for contact making or breaking.
   e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:
   a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
   b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:
   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:
   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
   b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.
3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION
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 control valves and actuators for DDC systems.

B. Related Requirements:

1. Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

2. Section 23 09 93.11 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 23 09 23.11.

1.3 DEFINITIONS

A. Cv: Design valve coefficient.

B. DDC: Direct-digital control.

C. NBR: Nitrile butadiene rubber.

D. PTFE: Polytetrafluoroethylene.

E. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.


4. Installation, operation, and maintenance instructions, including factors affecting performance.

B. Shop Drawings:
1. Include plans, elevations, sections, and details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for pneumatic signal and main air tubing.

C. Delegated-Design Submittal:

1. Schedule and design calculations for control valves and actuators, including the following:
   a. Flow at project design and minimum flow conditions.
   b. Pressure differential drop across valve at project design flow condition.
   c. Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.
   d. Design and minimum control valve coefficient with corresponding valve position.
   e. Maximum close-off pressure.
   f. Leakage flow at maximum system pressure differential.
   g. Torque required at worst case condition for sizing actuator.
   h. Actuator selection indicating torque provided.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Control valve installation location shown in relationship to room, duct, pipe, and equipment.
   2. Size and location of wall access panels for control valves installed behind walls.
   3. Size and location of ceiling access panels for control valves installed above inaccessible ceilings.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to size products where indicated as delegated design.
D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Backup Power Source: Systems and equipment served by a backup power source shall have associated control valve actuators served from a backup power source.

F. Environmental Conditions:

1. Provide electric control valve actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control valve actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.


G. Determine control valve sizes and flow coefficients by ISA 75.01.01.

H. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

I. Selection Criteria:

1. Control valves shall be suitable for operation at following conditions:


2. Control valve shutoff classifications shall be FCI 70-2, Class IV or better unless otherwise indicated.

3. Valve pattern, three-way or straight through, shall be as indicated on Drawings.

4. Modulating straight-through pattern control valves shall have equal percentage flow-throttling characteristics unless otherwise indicated.

5. Modulating three-way pattern water valves shall have linear flow-throttling characteristics. The total flow through the valve shall remain constant regardless of the valve's position.

6. Modulating butterfly valves shall have linear or equal percentage flow-throttling characteristics.

7. Fail positions unless otherwise indicated:


8. Globe-type control valves shall pass the design flow required with not more than 95 percent of stem lift unless otherwise indicated.

9. Rotary-type control valves, such as ball and butterfly valves, shall have Cv falling between 65 and 75 degrees of valve full open position and minimum valve Cv between 15 and 25 percent of open position.

10. Selection shall consider viscosity, flashing, and cavitation corrections.

11. Valves shall have stable operation throughout full range of operation, from design to minimum Cv.

12. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.

13. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow unless otherwise indicated.

14. Two-position control valves shall be line size unless otherwise indicated.

15. In water systems, use ball- or globe-style control valves for two-position control for valves NPS 2 and smaller and butterfly style for valves larger than NPS 2.

16. In steam systems, use ball- or globe-style control valves regardless of size.
17. Pneumatic, two-position control valves shall provide a smooth opening and closing characteristic slow enough to avoid water hammer. Valves with pneumatic actuators shall have an adjustable opening time (valve full closed to full open) and an adjustable closing time (valve full open to full closed) ranging from zero to 10 seconds. Opening and closing times shall be independently adjustable.

18. Control valve, pneumatic-control signal shall not exceed 200 feet. For longer distances, provide an electric/electronic control signal to the valve and an electric solenoid valve or electro-pneumatic transducer at the valve to convert the control signal to pneumatic.

2.2 BALL-STYLE CONTROL VALVES

A. Ball Valves with Full Ball and Characterized V-Notch:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Flow-Tek, Inc.

2. Performance:
   a. Process Temperature Rating: Minus 20 to plus 500 deg F.
   b. ASME B16.34, Class 600 for NPS 2 and smaller; Class 150 for larger than NPS 2.
   c. Leakage: FCI 70-2, Class VI, bi-directional.
   d. Rangeability: Varies from 200 to 1 up to 800 to 1 based on notch pattern of ball.
   e. Rotation: Zero to 90 degrees.
   f. Equal percentage flow characteristic.
   g. Full port.

3. Face-to-Face Dimension: ASME B16.10 long pattern.

4. Valves NPS 2 and Smaller: ASME B1.20.1 threaded (NPT) ends and three-piece body.

5. Valves NPS 2-1/2 through NPS 12: Flanged ends suitable for mating to ASME B16.5 flanges and two-piece body.

6. Hole in the stem slot of each ball equalizes pressure between the body cavity and the line media flow.

7. Replaceable seat, ball, and shaft packing.


10. Ball Seat: RPTFE.

   a. Primary Seal: Combination of thrust washer and thrust washer protector.

12. Stem Seals for Valves Larger than NPS 2: Independent packing gland, adjusted without removing mounting hardware or operator, and contoured to uniformly distribute load across packing.
   a. Primary Seal: Combination of thrust washer and thrust washer protector.

13. Label each valve with following:
   a. Manufacturer's name, model number, and serial number.
   b. Body size.
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b. Flow directional arrow.

B. Industrial-Grade Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2. Performance:
   a. Process Temperature Rating: Minus 20 to plus 450 deg F.
   b. ASME B16.34, Class 150.
   c. Leakage: FCI 70-2, Class VI.
   d. Rangeability: 300 to 1.
   e. Rotation: Zero to 90 degrees.
   f. Modified equal percentage flow characteristic.

3. Face-to-Face Dimensions: Comply with ASME B16.10 short pattern.

4. Body: Cast steel ASTM A216/A216M WCB.

5. Flanged Body: Suitable for mating to ASME B16.5 flanges.


7. Ball Seat: Reinforced PTFE.

8. PTFE V-ring packing, 316 stainless-steel packing follower.

9. Replaceable seat, ball, and shaft packings.

10. Replaceable 316 stainless-steel shaft bushings with PTFE linings.

11. Corrosion-resistant nameplate indicating the following:
    a. Manufacturer's name, model number, and serial number.
    b. Body size.
    c. Body and trim materials.
    d. Trim type.
    e. Body and flange rating.
    f. Arrow indicating direction of flow.

2.3 BUTTERFLY-STYLE CONTROL VALVES

A. Industrial-Grade Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2. Performance:
   a. Process Temperature Rating: Minus 200 to plus 849 deg F.
   b. ASME B16.34, Class 150 for larger sizes.
   c. Complies with MSS SP-68.
   d. Leakage: FCI 70-2, Class VI, bi-directional.
   e. Rangeability: 100 to 1.
   f. Rotation: Zero to 90 degrees.
   g. Linear or modified equal percentage flow characteristic.

7. Shaft Bushings: Reinforced PTFE or stainless steel.
8. Replaceable seat, disc, and shaft bushings.
9. Corrosion-resistant nameplate indicating:
   a. Manufacturer's name, model number, and serial number.
   b. Body size.
   c. Body and trim materials.
   d. Body rating.
   e. Arrow indicating direction of flow.

2.4 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Belimo Aircontrols (USA), Inc.
   2. Honeywell.
   4. Valve Solutions, Inc.

B. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

C. Position indicator and graduated scale on each actuator.

D. Type: Motor operated, with or without gears, electric and electronic.

E. Voltage: 24-V ac.

F. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

G. Function properly within a range of 85 to 120 percent of nameplate voltage.

H. Construction:
   1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
   2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
   3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

I. Field Adjustment:
   1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
   2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.
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J. Two-Position Actuators: Single direction, spring return or reversing type.

K. Modulating Actuators:

1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:
   a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
   b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10-V dc and 4- to 20-mA signals.
   c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.
   d. Programmable Multi-Function:
      1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
      2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
      3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.

L. Position Feedback:

1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

M. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

N. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

O. Valve Attachment:

1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

P. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

Q. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

R. Stroke Time:

1. Operate valve from fully closed to fully open within 60 seconds.
2. Operate valve from fully open to fully closed within 60 seconds.
3. Move valve to failed position within 30 seconds.
4. Select operating speed to be compatible with equipment and system operation.

S. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for valves installed in piping to verify actual locations of piping connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROL VALVE APPLICATIONS

A. Control Valves:

1. Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
2. Chilled water System, Two-Way Applications Controlled by Temperature: Ball valves with full ball and characterized V-notch Industrial-grade ball valves Butterfly-style valves, industrial-grade valves.

3.3 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 25lb force.

D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

F. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.

2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.

3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

H. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.

2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:

   a. Laboratory exhaust airstreams.
   b. Process exhaust airstreams.

3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.

4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.

5. Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.
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3.4 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

3.5 CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Install drain valves in piping upstream and downstream of each control valve installed in a three-valve manifold and for each control valve larger than NPS 2.

D. Install pressure temperature taps in piping upstream and downstream of each control valve larger than NPS 2.

E. Valve Orientation:
   1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
   2. Install valves in a position to allow full stem movement.
   3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

F. Clearance:
   1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
   2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.

G. Threaded Valves:
   1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
   2. Align threads at point of assembly.
   3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
   4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

H. Flanged Valves:
   1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.6 CONNECTIONS

A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with valve identification on valve.

3.8 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.9 CHECKOUT PROCEDURES

A. Control Valve Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check valves for proper location and accessibility.
3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. For pneumatic products, verify air supply for each product is properly installed.
5. For pneumatic valves, verify that pressure gauges are provided in each air line to valve actuator and positioner.
6. Verify that control valves are installed correctly for flow direction.
7. Verify that valve body attachment is properly secured and sealed.
8. Verify that valve actuator and linkage attachment are secure.
9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
10. Verify that valve ball, disc, and plug travel are unobstructed.
11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.
3.10 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer’s recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer’s recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION
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 pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Condensate-drain piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.
B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping: 300 psig at 200 deg F.
2. Chilled-Water Piping: 300 psig at 60 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Air-Vent Piping: 200 deg F.
5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
2. RTRP and RTRF with adhesive.
3. Pressure-seal fittings.
4. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
5. Air control devices.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
1.6 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For Installer.
   B. Welding certificates.
   C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS
   A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.9 QUALITY ASSURANCE
   A. Installer Qualifications:
      1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
   B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
      1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
      2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
   D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS
   A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
   B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
   C. DWV Copper Tubing: ASTM B 306, Type DWV.
   D. Wrought-Copper Fittings: ASME B16.22.
   E. Wrought-Copper Unions: ASME B16.22.
2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.


E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   2. End Connections: Butt welding.
   3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Description:
      b. Pressure Rating: 300 psig minimum at 180 F.
      c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Description:
      b. Factory-fabricated, bolted, companion-flange assembly.
      c. Pressure Rating: 300 psig minimum at 180 deg F.
      d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Description:
      a. Nonconducting materials for field assembly of companion flanges.
      b. Pressure Rating: 300 psig.
      c. Gasket: Neoprene or phenolic.
      d. Bolt Sleeves: Phenolic or polyethylene.
      e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:
   1. Description:
      a. Standard: IAPMO PS 66
      b. Electroplated steel nipple. complying with ASTM F 1545.
      c. Pressure Rating: 300 psig at 180 deg F.
      d. End Connections: Male threaded or grooved.
      e. Lining: Inert and noncorrosive, propylene.

2.5 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:
1. **Basis-of-Design Product**: Subject to compliance with requirements, provide comparable product by one of the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Gerand Engineering Co.
   e. Griswold Controls.
   f. Taco.

2. **Body**: Bronze, ball or plug type with calibrated orifice or venturi.
3. **Ball**: Brass or stainless steel.
4. **Plug**: Resin.
5. **Seat**: PTFE.
6. **End Connections**: Threaded or socket.
7. **Pressure Gage Connections**: Integral seals for portable differential pressure meter.
8. **Handle Style**: Lever, with memory stop to retain set position.
9. **CWP Rating**: Minimum 300 psig.
10. **Maximum Operating Temperature**: 250 deg F.

**D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves**:
1. **Basis-of-Design Product**: Subject to compliance with requirements, provide comparable product by one of the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Gerand Engineering Co.
   e. Griswold Controls.
   f. Taco.
   g. Tour & Andersson; available through Victaulic Company.

2. **Body**: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. **Ball**: Brass or stainless steel.
4. **Stem Seals**: EPDM O-rings.
5. **Disc**: Glass and carbon-filled PTFE.
6. **Seat**: PTFE.
7. **End Connections**: Flanged or grooved.
8. **Pressure Gage Connections**: Integral seals for portable differential pressure meter.
9. **Handle Style**: Lever, with memory stop to retain set position.
10. **CWP Rating**: Minimum 300 psig.
11. **Maximum Operating Temperature**: 250 deg F.

**E. Diaphragm-Operated, Pressure-Reducing Valves**:
1. **Basis-of-Design Product**: Subject to compliance with requirements, provide comparable product by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: Removable without system shutdown.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
8. Inlet Strainer: Removable without system shutdown.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.6 AIR CONTROL DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Manual Air Vents:
   a. Body: Bronze.
   b. Internal Parts: Nonferrous.
   c. Operator: Screwdriver or thumbscrew.
   d. Inlet Connection: NPS 1/2.
   f. CWP Rating: 300 psig.
   g. Maximum Operating Temperature: 225 deg F.

2. Automatic Air Vents:
   a. Body: Bronze or cast iron.
   b. Internal Parts: Nonferrous.
   c. Operator: Noncorrosive metal float.
   d. Inlet Connection: NPS 1/2.
   e. Discharge Connection: NPS 1/4.
   f. CWP Rating: 300 psig.
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2.7 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 300 psig.

B. Stainless-Steel Bellow, Flexible Connectors:
2. End Connections: Threaded or flanged to match equipment connected.
4. CWP Rating: 300 psig.
5. Maximum Operating Temperature: 250 deg F.

C. Bladder-Type Expansion Tanks:
1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to drain water, and close off system.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and pressure-seal joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be the following:
1. Schedule 40 steel pipe; Class 250, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
E. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

F. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

G. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
   2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

H. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.
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I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

Y. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.

2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.


H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.


3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
4. Set temperature controls so all coils are calling for full flow.
5. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
6. Verify lubrication of motors and bearings.

END OF SECTION
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 special-duty valves and specialties for the following:

1. Chilled water piping.
2. Makeup-water piping.
3. Condensate-drain piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Chilled Heating Piping: 150 psig 200 deg F.
2. Makeup-Water Piping: 80 psig 150 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Air-Vent Piping: 200 deg F.
5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

A. Ball, and Butterfly Valves: Comply with requirements specified in Section 23 05 23 "Valves for HVAC Piping."

B. Automatic Flow-Control Valves:
   1. Body: Brass or ferrous metal.
   2. Piston and Spring Assembly: Corrosion resistant, tamper proof, self-cleaning, and removable.
   3. Combination Assemblies: Include bronze or brass-alloy ball valve.
   4. Identification Tag: Marked with zone identification, valve number, and flow rate.
   5. Size: Same as pipe in which installed.
   6. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
   8. Maximum Operating Temperature: 250 deg F.

2.3 AIR-CONTROL DEVICES

A. Automatic Air Vents:
   1. Body: Bronze or cast iron.
   2. Internal Parts: Nonferrous.
   4. Inlet Connection: NPS 1/2.
   7. Maximum Operating Temperature: 240 deg F.

B. Bladder-Type Expansion Tanks:
   1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

C. Centrifugal-Type Air Separators:
1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
5. Size: Match system flow capacity.

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.

B. Stainless-Steel Bellow, Flexible Connectors:
2. End Connections: Threaded or flanged to match equipment connected.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves in the return pipe of each cooling terminal.

C. Install check valves at each pump discharge and elsewhere as required to control flow direction.

D. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from air separator to expansion tank with a 2 percent upward slope toward tank.
D. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

E. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION
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. Single-wall rectangular ducts and fittings.
   2. Single-wall round ducts and fittings.
   4. Duct liner.
   5. Sealants and gaskets.
   6. Hangers and supports.

B. Related Sections:
   1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
   2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mouting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.

B. Shop Drawings: Plans and details, drawn to scale, on which the following items are shown.
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, vibration isolation and duct attachment.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints,"
for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lindab Inc.
   b. McGill AirFlow LLC.
   c. SEMCO Incorporated.
   d. Sheet Metal Connectors, Inc.
   e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   a. CertainTeed Corporation; Insulation Group.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.

2. Maximum Thermal Conductivity:
   1) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
   a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.

8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 3 inches.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
   10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

   1. Application Method: Brush on.
   2. Base: Synthetic rubber resin.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.
2. Type: S.
3. Grade: NS.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.


3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

2. Test the following systems:
   a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Engineer from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
   b. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Engineer from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
   c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Engineer from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
   d. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Engineer from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
   e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Engineer from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days’ advanced notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.
   1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:
   1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
   2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
   7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:
   1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
   2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
   3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Supply Ducts:

1. Ducts Connected to Terminal Units:
   a. Pressure Class: Positive 1-inch wg.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
   a. Pressure Class: Positive 3-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round and Flat Oval: 3.

3. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

B. Return Ducts:

1. Ducts Connected to Terminal Units:
   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 2-inch wg.
      b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.

D. Outdoor-Air Ducts:
   1. Ducts Connected to Air Handling Units:
      a. Pressure Class: Positive or negative 3-inch wg.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.

E. Intermediate Reinforcement:

F. Liner:
   1. Supply Air Ducts: Fibrous glass, Type II, 1-1/2 inches thick.
   2. Return Air Ducts: Fibrous glass, Type II, 2 inches thick.
   4. Supply Fan Plenums: Fibrous glass, Type II, 2 inches thick.
   5. Transfer Ducts: Fibrous glass, Type II, 1-1/2 inches thick.

G. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
      a. Velocity 1000 fpm or Lower:
         1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      b. Velocity 1000 to 1500 fpm:
         1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
METAL DUCTS
Section: 23 31 13

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

   1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
   2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
   3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

   a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch upstream of VAV Terminal Units: Conical
c. Rectangular Main to Round Branch downstream of VAV Terminal Units: Spin in.

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees."

   Saddle taps are permitted in existing duct.

   a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION
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. Single-duct air terminal units.
2. Fan-powered air terminal units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products, including rated capacities, furnished
specialties, sound-power ratings, and accessories.

1. Air terminal units.
2. Liners and adhesives.
3. Sealants and gaskets.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with
ASHRAE 62.1, Section 5 - "Systems and Equipment."

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items
are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Size and location of initial access modules for acoustic tile.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers,
access panels, and special moldings.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and
maintenance manuals. In addition to items specified in Division 01 Section "Operation and
Maintenance Data," include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.
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. Fan-Powered-Unit Filters: Furnish one spare filter(s) for each filter installed.

1.7 QUALITY ASSURANCE

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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Price.
2. Carrier Corporation.
3. Titus.
5. Environmental Technologies.

B. Configuration: Diverting-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.034-inch steel, single wall.

1. Casing Lining: Adhesive attached, 1/2-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

   a. Cover liner with nonporous foil.

2. Air Inlet: Round stub connection for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to diverting damper and other parts requiring service, adjustment, or maintenance; with airtight gasket.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Diverter Assembly: Aluminum blade, with nylon-fitted pivot points.
2.2 SERIES FAN-POWERED AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anemostat Products; a Mestek Company.
2. Carnes.
3. Environmental Technologies, Inc.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Price Industries.
8. Titus.
10. Tuttle & Bailey.

B. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.034-inch steel, single wall.

1. Casing Lining: Adhesive attached, 1/2-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

   a. Cover liner with nonporous foil.

2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
5. Fan: Forward-curved centrifugal.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.

E. Velocity Sensors: Multipoint array with velocity sensors in cold- and hot-deck air inlets and air outlets.

F. Motor:

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Type: Permanent-split capacitor with SCR for speed adjustment.
4. Enclosure: Open dripproof.
G. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Material: 2 inches, pleated cotton-polyester media having 90 percent arrestance and 7 MERV.

H. Attenuator Section: 0.034-inch steel sheet.
   1. Lining: Adhesive attached, 1/2-inch-thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
      a. Cover liner with nonporous foil.
   2. Lining: Adhesive attached, 3/4-inch-thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
   3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

I. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
   1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
   2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
   3. Disconnect Switch: Factory-mounted, fuse type.

J. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

K. Electric Controls: 24-V damper actuator with wall-mounted electric thermostat and appropriate mounting hardware.

L. Electronic Controls: Bidirectional damper operator and microprocessor-based controller with integral airflow transducer and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:
   1. Occupied and unoccupied operating mode.
   2. Remote reset of airflow or temperature set points.
   3. Adjusting and monitoring with portable terminal.
   4. Communication with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Install wall-mounted thermostats.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

A. Install piping adjacent to air terminal unit to allow service and maintenance.

B. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts." Coordinate duct installations and specialty arrangements with Drawings.

C. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.
3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
   1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
   2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Air terminal unit will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
   3. Verify that controls and control enclosure are accessible.
   4. Verify that control connections are complete.
   5. Verify that nameplate and identification tag are visible.
   6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION
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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. Rectangular and square ceiling diffusers.
   2. Perforated diffusers.
   3. Linear slot diffusers.

B. Related Sections:
   1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
   2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.

B. Source quality-control reports.
PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

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:

   b. Anemostat Products; a Mestek company.
   c. Carnes.
   d. Hart & Cooley Inc.
   e. Krueger.
   f. METALAIRE, Inc.
   g. Nailor Industries Inc.
   h. Price Industries.
   i. Titus.
   j. Tuttle & Bailey.

4. Face Size: As shown on schedules.
5. Face Style: Three cone.

B. Perforated Diffuser:

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. Air Research Diffuser Products, Inc.
   b. A-J Manufacturing Co., Inc.
   c. Anemostat Products; a Mestek company.
   d. Carnes.
   e. Hart & Cooley Inc.
   f. Krueger.
   g. METALAIRE, Inc.
   h. Nailor Industries Inc.
   i. Price Industries.
   j. Titus.
   k. Tuttle & Bailey.
   l. Warren Technology.
   m. American Louver Co.

2. Material: Steel backpan and pattern controllers, with steel face.
4. Face Size: As shown on schedules.
5. Duct Inlet: Round.
2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Slot Diffuser:

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. Air Research Diffuser Products, Inc.
   b. Anemostat Products; a Mestek company.
   c. Carnes.
   d. Hart & Cooley Inc.
   e. Krueger.
   f. METALAIRE, Inc.
   g. Nailor Industries Inc.
   h. Price Industries.
   i. Titus.
   j. Tuttle & Bailey.
   k. American Louver Co.

4. Finish - Face and Shell: Baked enamel, black.
5. Finish - Pattern Controller: Baked enamel, black.
7. Slot Width: 1/2 inch.
8. Number of Slots: Two.
10. Accessories: Plaster frame.

2.3 REGISTERS AND GRILLES

A. Fixed Face Grille:

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:

   b. Anemostat Products; a Mestek company.
   c. Carnes.
   d. Dayus Register & Grille Inc.
   e. Hart & Cooley Inc.
   f. Krueger.
   g. Nailor Industries Inc.
   h. Price Industries.
   i. Titus.
   j. Tuttle & Bailey.
   k. American Louver Co.

7. Mounting: Countersunk screw.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION
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 hydronic heating and cooling air coils.

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 each air coil.
   2. Include rated capacities, operating characteristics, and pressure drops for each air coil.

1.4 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

1.5 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.6 FIELD CONDITIONS
A. Altitude above Mean Sea Level: 200ft.

PART 2 - PRODUCTS

2.1 DESCRIPTION
A. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 COILS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aerofin.
2. Carrier Corporation; a unit of United Technologies Corp.
3. Coil Company, LLC.
5. USA Coil & Air.

B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.

C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.

D. Source Quality Control: Factory tested to 300 psig.

E. Tubes: ASTM B 743 copper, minimum 0.025 thick.

F. Fins: Aluminum, minimum 0.008” thick.

G. Headers: Seamless copper tube with brazed joints, prime coated.

H. Frames: Galvanized-steel channel frame, minimum 0.064 inch thick for slip-in mounting.

I. Frames: ASTM A 666, Type 304 stainless steel, minimum 0.0625 inch thick for slip-in mounting.
   a.

J. Chilled-Water Coil Capacities and Characteristics:

   1. Coil Face Dimensions:
      a. Finned Length: 130 in.
      b. Finned Width: 40.5 in.

   2. Minimum Fin Spacing: 0.008 in.
   3. Tube Diameter: 0.625 inch.
   4. Number of Rows: 10.
   5. Serpentine: 1.25.
   7. Coating: None.
   8. Air Side:
      a. Flow Rate: See dwg.
      b. Finned Area Face Velocity: See dwg
      c. Static Pressure Drop: See dwg
      d. Total Capacity: See dwg
      e. Sensible Capacity: See dwg
      f. Entering Dry-Bulb Temperature: See dwg
      g. Entering Wet-Bulb Temperature: See dwg
      h. Leaving Dry-Bulb Temperature: See dwg
      i. Leaving Wet-Bulb Temperature: See dwg.

   9. Water Side:
      a. Flow Rate: See dwg
      b. Tube Velocity: See dwg
      c. Glycol Type: None
      d. Aqueous Glycol Solution Concentration: None
      e. Pressure Drop: See dwg
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Install [galvanized] [stainless]-steel drain pan under each cooling coil.

1. Construct drain pans with connection for drain; insulated and complying with ASHRAE 62.1.
2. Construct drain pans to extend beyond coil length and width and to connect to condensate trap and drainage.
3. Extend drain pan upstream and downstream from coil face.
4. Extend drain pan under coil headers and exposed supply piping.

D. Install moisture eliminators for cooling coils. Extend drain pan under moisture eliminator.

E. Straighten bent fins on air coils.

F. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Section 23 09 23.11 "Control Valves," and other piping specialties are specified in Section 23 21 16 "Hydronic Piping Specialties."

END OF SECTION
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 prefabricated radiant-heating electric panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, and furnished specialties and
      accessories.

B. Shop Drawings: For electric heating panels.
   1. Include plans, sections, details, and attachments to other work.
   2. Include diagrams for power, signal, and control wiring.

C. Samples for Verification for Radiant-Panel Finishes: 15” x 24” and 21” x 46”.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are
   shown and coordinated with each other, using input from installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Structural members to which heating panels and suspension systems will be attached.
   4. Items installed in finished ceiling, including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Perimeter moldings.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.
1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric heating panels to include in operation and maintenance manuals.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace electric heating panels that fail in materials or workmanship within specified warranty period.

1. Warranty Period: one years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR RADIANT-HEATING ELECTRIC PANELS

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.

2.2 PREFABRICATED RADIANT-HEATING ELECTRIC PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chromalox
2. Berko; Marley Engineered Products.
3. Detroit Radiant Products Company.
4. QMark; Marley Engineered Products.
5. SSHC, Inc.

B. Description: Sheet-metal-enclosed panel with heating element suitable for surface mounting. Comply with UL 2021. ETL, CSA 22.2 #46.

1. Panel: Extruded aluminum housing. With high temperature nylon louvered end caps.
3. Electrical Connections: Non-heating, high-temperature, insulated-copper leads, factory connected to heating element.
4. Exposed-Side Panel Finish: Aluminum finish in manufacturer's standard paint color as selected by Architect.
5. Hung-Mounted Trim: Sheet metal with baked-enamel finish in manufacturer's standard silver paint color as selected by Architect.

C. Wall Thermostat: Bimetal, sensing elements calibrated from 55 to 90 deg F; with contacts suitable for [low] [line]-voltage circuit, and manually operated on-off switch with contactors, relays, and control transformers.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating panels for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Ensure surfaces in contact with electric heating panels are free of burrs and sharp protrusions.
2. Ensure surfaces and substrates are level and plumb.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install radiant-heating panels level and plumb.

B. Support for Radiant-Heating Panels in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling-support-system rods or wires for each panel. Locate not more than 6 inches from panel corners.
2. Support Clips: Fasten to panel and to ceiling grid members at or near each panel corner with clips designed for the application.
3. Panels of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support panels independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

C. Verify locations of thermostats with Drawings and room details before installation. Install devices 60 inches above finished floor.

3.3 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operate electric-heating elements through each stage to verify proper operation and electrical connections.
2. Test and adjust controls and safeties.

B. Radiant-heating electric panels will be considered defective if they do not pass tests and inspections.
C. Prepare test and inspection reports.

3.5 PROTECTION

A. Protect installed radiant-heating electric panels from damage during construction.

B. Remove and replace damaged radiant-heating electric panels.

END OF SECTION
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 requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Division 01 Section "Submittal Procedures" for coordinating Division 22 and 23 submittals with other Divisions.
2. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
3. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Division 01 Section "Demonstration and Training" for demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's and Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.


1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making
corrections or revisions to submittals noted by Architect and Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Engineer's Digital Data Files: Electronic digital data files used to produce the Contract Drawings will be provided by Engineer for Contractor's use in preparing submittals only after Engineer's Release Form has been appropriately executed.

1. Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
   a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
   b. Digital Drawing Software Program: The Contract Drawings are available in Autodesk AutoCAD and Autodesk Revit formats.
   c. Contractor shall execute a data licensing agreement (Engineer's Release Form) in substantial agreement with AIA Document C106, Digital Data Licensing Agreement.
   d. The Contractor agrees as a pre-condition of the use of Engineer’s digital data files to provide Engineer with Contractor’s final files (Record Drawings) at the completion of the project in the same software version and with same electronic properties (layers, families, etc.) as provided by Engineer.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
   a. Architect and Engineer reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer and Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: One resubmittal is allowed. Additional resubmittal reviews will be performed after Engineer's review fees have been negotiated. Allow 15 days for review of each resubmittal.
D. Paper Submittals: Paper submittals will not be allowed.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
   a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and Engineer.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Engineer and Architect, containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.
   n. Related physical samples submitted directly.
   o. Indication of full or partial submittal.
   p. Transmittal number, numbered consecutively.
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.
5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

F. Options: Identify options requiring selection by Architect.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract.
Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's and Engineer's action stamp.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Engineer's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals as PDF electronic files via email or directly to Project Web site.
2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.

3. Submit Shop Drawings in the following format:
   a. PDF electronic file.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:
   a. PDF electronic file.

E. Coordination Drawing Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

F. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."

G. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

H. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.
I. **Welding Certificates:** Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

J. **Installer Certificates:** Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

K. **Manufacturer Certificates:** Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

L. **Product Certificates:** Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

M. **Material Certificates:** Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

N. **Material Test Reports:** Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

O. **Product Test Reports:** Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

P. **Research Reports:** Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

Q. **Preconstruction Test Reports:** Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

R. **Compatibility Test Reports:** Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

S. **Field Test Reports:** Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Engineer.

B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. Engineer's Review
   a. No Exceptions Taken: Engineer's review found no apparent discrepancies between submittal data and requirements of Contract Documents. No further submittal review action required from Contractor.
   b. Accepted as Noted: Engineer's review found the submittal to be in substantial conformance with the requirements of Contract Documents.
   c. Rejected: Engineer's review found the submittal to be in non-conformance with the requirements of Contract Documents.

2. Responses required by Contractor:
   a. Confirm: Contractor will review Engineer's notations on submittal and confirm via written response the information requested by Engineer.
   b. Revise: Contractor will review Engineer's notations on submittal and revise submittal to comply.
   c. Resubmit: Contractor will make changes to submittal in accordance with Engineer's notations and resubmit.

3. Additional Requirements:
   a. Requires Review and Approval by _______: In addition to Engineer's review of submittal, the submittal must be officially submitted and approved by the authority noted.

B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Engineer.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.
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. Building wires and cables rated 600 V and less.
      2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For testing agency.
   B. Field quality-control reports.

1.5 QUALITY ASSURANCE
   A. Testing Agency Qualifications: Member company of NETA or an NRTL.
      1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES
   A. Subject to compliance with requirements, provide product by one of the following:
      1. Alpha Wire.
      2. Encore Wire Corporation.
      3. General Cable Technologies Corporation.
      5. Senator Wire & Cable Company
   B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2, Type THHN-2, THWN-2 or Type XHHW-2.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for armored cable, Type AC with ground wire in lengths not over 6 ft.

2.2 CONNECTORS AND SPLICES

A. Subject to compliance with requirements, provide product by one of the following:
   1. AFC Cable Systems, Inc.
   2. Gardner Bender.
   4. Ideal Industries, Inc.
   5. Ilsco; a branch of Bardes Corporation.
   6. O-Z/Gedney; a brand of the EGS Electrical Group.
   7. 3M; Electrical Markets Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 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 NFPA 70.

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. 10 and No. 12 AWG and smaller; stranded for No. 8 and No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Feeders in Cable Tray: Type THHN-2-THWN-2, single conductors or Type XHHW-2, single conductors larger than No. 1/0 AWG.
E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

H. VFC Output Circuits: Type XHHW-2 in metal conduit.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.4 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 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.
3.6 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 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 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 07 84 13 "Penetration Firestopping."

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 the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Infrared Scanning: After Substantial Completion, but not more than 60 days after 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. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test and Inspection Reports: Prepare a written report 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.

E. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION
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.
   B. Qualification Data: For testing agency and testing agency's field supervisor.
   C. Field quality-control reports.

1.4 QUALITY ASSURANCE
   A. Testing Agency Qualifications: Member company of NETA or an NRTL.
      1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
   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 UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Burndy; Part of Hubbell Electrical Systems.
      2. Dossert; AFL Telecommunications LLC.
      3. ERICO International Corporation.
2.2 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.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

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.

2.4 CONNECTORS

A. 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.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Isolated Grounding Conductors: Green-colored insulation with 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.

C. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

3.2 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.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.

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.

3.3 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. 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.

C. 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.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. 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.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
   5. Maximum ground resistance at any point within the electrical system shall not exceed 15 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS
A. Welding certificates.

1.7 QUALITY ASSURANCE
A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Comply with NFPA 70.

1.8 COORDINATION
A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 07 72 00 "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS
A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Atkore International.
      g. Wesanco, Inc.
   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   5. Channel Dimensions: Selected for applicable load criteria.
B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored 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 malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] [stainless] steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti, Inc.
      4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

5. Toggle Bolts: All-steel springhead type.


7. Powder-Actuated Fasteners are not permitted.

2.2 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 05 50 00 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. 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 or single-bolt conduit clamps using spring friction action for retention in support channel.

D. 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, IMC, and RMC may be supported by openings through structure members, as permitted in 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. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 Spring-tension clamps.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05 50 00 "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 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 09 91 13 "Exterior Painting" Section 09 91 23 "Interior Painting" and Section 09 96 00 "High Performance Coatings" 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 A 780.

END OF SECTION
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, tubing, and fittings.
      2. Nonmetal conduits, tubing, and fittings.
      3. Metal wireways and auxiliary gutters.
      4. Nonmetal wireways and auxiliary gutters.
      5. Surface raceways.
      7. Handholes and boxes for exterior underground cabling.
   B. Related Requirements:
      1. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
      2. Section 27 05 28 "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.
   C. IMC: Intermediate metal 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.
1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AFC Cable Systems, Inc.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney.
6. Picoma Industries.
7. Republic Conduit.
8. Robroy Industries.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.
D. ARC: Comply with ANSI C80.5 and UL 6A.
E. IMC: Comply with ANSI C80.6 and UL 1242.
F. EMT: Comply with ANSI C80.3 and UL 797.
G. FMC: Comply with UL 1; zinc-coated steel.
H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

   a. Material: Steel.
b. Type: Compression.

3. 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.

4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corporation.
7. Electri-Flex Company.
8. Kraloy.
9. Lamson & Sessions; Carlon Electrical Products.
10. Niedax-Kleinhuis USA, Inc.
11. RACO; Hubbell.
12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. LFNC: Comply with UL 1660.

E. Rigid HDPE: Comply with UL 651A.

F. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

G. Fittings for LFNC: Comply with UL 514B.

H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R Type 4 Type 12 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 type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
5. FSR Inc.
8. Kraloy.
10. Mono-Systems, Inc.
12. RACO; Hubbell.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures.
17. Wiremold / Legrand.

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. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully 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.
F. 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.

G. 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.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

L. Gangable boxes are allowed provided devices are de-rated per manufacturer's requirements.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 Type 3R Type 4 Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:
   1. NEMA 250, Type 1 Type 3R Type 12 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.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Use the following wiring methods:
   1. Exposed: PVC rigid conduit.
   2. Concealed: PVC rigid conduit.
   3. Connection to Vibrating Equipment: Including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment: liquidtight flexible metal conduit.
   4. Indoors or Outdoors: Connection to vibrating equipment and hydraulic, pneumatic, or electric solenoid or motor-driven equipment in moist or humid location or corrosive atmosphere, or where subject to water spray or dripping oil, grease, or water: liquidtight flexible metal conduit.
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
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B. Indoors: Use the following wiring methods:
1. Connection to Vibrating Equipment: Including transformers and hydraulic, pneumatic or electric solenoid or motor-operated equipment: flexible metal conduit.
2. Exposed: electrical metallic tubing.
4. For service entrance and generator feeders, use GRC conduit with watertight seals at any penetration through exterior walls.

C. Electrical Metallic Tubing (EMT) shall not be used in the following locations or under the following conditions:
1. Outside structure or on roof.
2. At or below grade.
3. In or beneath slabs on grade.
4. In hazardous locations.
5. Where exposed to physical damage, e.g. mechanical rooms.
6. Where subject to excessive moisture or deterioration.
7. For service entrance and generator feeders.

D. Minimum Raceway Size: 3/4-inch trade size.

E. 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. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

F. 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.

G. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

H. Install surface raceways only where indicated on Drawings.

I. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. 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.

B. 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.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
E. 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.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches of enclosures to which attached.

H. 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.

I. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

K. 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 trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

L. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

M. 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.

N. 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.

O. 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.

P. 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.

Q. 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.

R. 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. Where otherwise required by NFPA 70.

S. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

T. 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.

U. 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.

V. 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.

W. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

X. Locate boxes so that cover or plate will not span different building finishes.

Y. 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.

Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

AA. Set metal floor boxes level and flush with finished floor surface.

BB. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

CC.

3.3 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 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
3.5 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
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.
5. Silicone sealants.

B. Related Requirements:

1. Section 07 84 13 "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:

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 D 1785, 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.
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABELING
Section: 26 05 44

F. Sleeves for Rectangular Openings:
   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 the following:
      a. Advance Products & Systems, Inc.
      b. CALPICO, Inc.
      c. Metraflex Company (The).
      d. Pipeline Seal and Insulator, Inc.
      e. Proco Products, Inc.

   2. Sealing Elements: EPDM or Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Stainless steel.
   4. Connecting Bolts and Nuts: Stainless steel 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, provide products by the following:
      a. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.


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.
2. Sealants and Sealant Primers shall comply with South Coast Air Quality Management District (SCAQMD) Rule #1168, amendment date January 7, 2005.
3. Sealant shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrink 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 07 92 00 "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.

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. Rooft-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] [cast-iron] 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
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. Identification for raceways.
   2. Identification of power and control cables.
   3. Identification for conductors.
   5. Warning labels and signs.
   6. Instruction signs.
   7. Equipment identification labels.
   8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS
A. Product Data: For each electrical identification product indicated.
B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE
B. Comply with NFPA 70.
D. Comply with ANSI Z535.4 for safety signs and labels.
E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:
   1. White letters on a red field.
   2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
2.3 CONDUCTOR IDENTIFICATION MATERIALS
   A. Refer to Section 26 05 19 - Low-Voltage Electrical Power Conductors And Cables

2.4 FLOOR MARKING TAPE
   A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.5 WARNING LABELS AND SIGNS
   B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

2.6 INSTRUCTION SIGNS
   A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
      1. Engraved legend with white letters on red face.
      2. Punched or drilled for mechanical fasteners.

2.7 EQUIPMENT IDENTIFICATION LABELS
   A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background. Minimum letter height shall be ¾ inch.

2.8 CABLE TIES
   A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
      2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
      3. Temperature Range: Minus 40 to plus 185 deg F.
   B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
      2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
      3. Temperature Range: Minus 40 to plus 185 deg F.
   C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 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. Select 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 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 25-foot maximum intervals in straight runs, and at 15-foot maximum intervals in congested areas.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.
3.2 IDENTIFICATION SCHEDULE

A. 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 vinyl label. Install labels at 10-foot maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
   2. Power.
   3. UPS.

C. Power-Circuit Conductor Identification, 600 V or Less: Refer to Section 26 05 19 - Low-Voltage Electrical Power Conductors And Cables

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes with the conductor designation.

G. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.

   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.
   4. 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.

J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled (as applicable):
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
   b. Disconnects.
   c. Enclosures and electrical cabinets.
   d. Access doors and panels for concealed electrical items.
   e. Emergency system boxes and enclosures.
   f. Motor-control centers.
   g. Enclosed switches.
   h. Enclosed circuit breakers.
   i. Enclosed controllers.
   j. Variable-speed controllers.
   k. Push-button stations.
   l. Power transfer equipment.
   m. Contactors.
   n. Remote-controlled switches, dimmer modules, and control devices.
   o. Power-generating units.
   p. Monitoring and control equipment.

END OF SECTION