

NOVEMBER 14, 2024

90% CONTRACT DOCUMENTS

**HILLSBOROUGH COUNTY
THONOTOSASSA FIRE STATION #21
REPLACEMENT
CIP NO. C91210000**

HILLSBOROUGH COUNTY BOARD OF COUNTY COMMISSIONERS

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DESIGN TEAM

Architect

WILDERARCHITECTURE, INC.

Structural Engineer

Pennoni Associate, Inc.

Mechanical Engineering Consultant

Engineering Matrix, Inc.

Electrical Engineering Consultant

Engineering Matrix, Inc.

Civil Engineering Consultant

Campo Engineering, Inc.

Landscape Architect

Anderson Lesniak Limited, Inc.

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SECTION 010100 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY OF CONTRACTOR'S (CONTRACTOR'S) SCOPE OF WORK

- A. The Summary of **CONTRACTOR'S** Scope of Work is generally described herein: In general, the name of the Project is the "**THONOTOSASSA FIRE STATION No. 21 REPLACEMENT**". The Work includes but is not limited to the furnishing of all labor, materials, equipment, permitting services, field engineering, construction management, and project administration/supervision activities to construct fully finished and functional fire station. The facility must be of high quality and low maintenance; must meet or exceed the requirements of the Construction Documents Package and must meet the needs of the user and maintenance agencies. The construction of this facility shall meet the requirements of all governing local, state, and federal regulations, codes and ordinances, including the Florida Accessibility Code for Building Construction and the Americans with Disabilities Act (ADA).

Project Location: The site is located at 10508 Main Street, Thonotosassa, FL 33592.

- C. Generally the construction work includes, but is not limited to: Construction of a single story approximately 7,328 sq. ft. 2-bay fire station building, together with all associated on-site and off-site improvements such as access drives, parking lot, dumpster enclosure, sign, flagpole, landscaping, irrigation, storm drainage system, sidewalks, fences, refueling facility and all necessary utilities, including onsite septic system, potable water, a fire sprinkler system (NFPA 13 system) with associated on-site water supply tank with related electrical controls & Fire Alerting System.

Refer to Drawings and Specifications for full extent of work.

- D. The **CONTRACTOR** shall have custody of the Project site for the duration of the Project and shall be responsible for the maintenance and security of the site and the proposed improvements. The adjoining private properties are occupied, and their operations must not be disrupted throughout the construction time.
- E. The Work shall be complete, and all Work, materials, and services not expressly shown or called for in the Contract Documents which may be necessary for the complete and proper construction of the Work shall be performed, furnished and installed by the **CONTRACTOR** in good faith as though originally so specified or shown, at no increased cost to **COUNTY**.

1.3 WORK BY OTHERS

- A. The **CONTRACTOR'S** attention is directed to the fact that Work may be conducted at the site by other contractors during the performance of the Work under this Contract. The **CONTRACTOR** shall conduct the operations so as to cause a minimum of interference with the Work of such other

contractors and shall cooperate fully with such contractors and the project representative to provide continued safe access to their respective portions of the site, as required to perform their respective contracts.

1.4 **NOISE CONTROL**

- A. **THE CONTRACTOR** shall eliminate noise within the project area to the extent possible. All local ordinances and regulations covering noise control shall be observed.

1.5 **STORAGE**

- A. Storage conditions shall be acceptable to **the COUNTY** for all materials and equipment not incorporated into the Work but included in Applications for Payment. Such storage arrangements and conditions shall be presented in writing for **the COUNTY's** review and approval and shall afford adequate and satisfactory security and protection. Off-site storage facilities shall be accessible to the Project Manager. The stored materials shall be insured for full value. Certificates of liability insurance coverage must be submitted to the Project Manager with the request for payment by the **CONTRACTOR**. All arrangements and costs for storage facilities shall be paid by the **CONTRACTOR**.

1.6 **NOTICES TO OWNERS AND AUTHORITIES**

CONTRACTOR shall notify all property owners and owners of utilities when prosecution of the Work may affect them.

CONTRACTOR shall review with the various utility companies the construction methods and work to be done in the vicinity of utilities.

CONTRACTOR must coordinate the use of and work within the road rights of way with the agencies having jurisdiction.

1.7 **REFERENCE STANDARDS**

- A. Reference to the standards of any technical society, organization, or association or to codes of local or state authorities shall mean the latest effective standard, code, specification, or standard adopted and published at the date of receipt of bids, unless specifically stated otherwise.

1.8 **DUST/DIRT CONTROL**

- A. The **CONTRACTOR** shall be careful not to create dust or dirt during demolition or other activities. The **CONTRACTOR** is responsible for any and all damage as a result of the Work.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION 010100

010300 – ALTERNATES

PART I - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

This Section specifies administrative and procedural requirements for Alternates.

- A. Definition: An Alternate is an amount proposed by Bidders and stated on the Bid Form for certain construction activities defined in the Bidding Requirements that may be added to or deducted from Base Bid amount if the **COUNTY** decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems or installation methods described in Contract Documents.
- B. Coordination: Coordinate related **WORK** and modify or adjust adjacent WORK as necessary to ensure that **WORK** affected by each accepted Alternate is complete and fully integrated into the project.
- C. Schedule: A “Schedule of Alternates” is included herein in this Section. Specification Sections referenced in the Schedule contain requirements for materials and methods necessary to achieve the WORK described under each Alternate.
 - 1. Include as part of each Alternate, miscellaneous devices, accessory objects and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - SCHEDULE OF ALTERNATES

3.1 DESCRIPTION OF ALTERNATES

A. Additive Alternate No. 1- Aboveground Diesel Fuel Tank System:

Base Bid: Base Bid does not include the aboveground refueling facility.

Additive: Add to the scope of work for the Contractor to furnish and install a 2000 Gal. aboveground diesel fuel tank with all its associated fuel pump, Retractable hose retriever, Nozzle, Fuel Master, Veeder Root, Remote fill box and low voltage cabling. Make all final connections and include start-up and programming of the system.

Note: All associated electrical, data conduits (with pull string), concrete pad and bollards associated with fuel tank facility shall be provided as part of base bid.

B. Additive Alternate No. 2 - Back-up Diesel Generator Power System:

Base Bid: Contractor shall install the Owner-furnished generator and furnish/install the automatic transfer switches under the base bid including start-up and load bank testing.

Additive: Add to the scope of work for the Contractor to furnish the generator.

Note: Contractor shall be responsible to provide and install Transfer Switch, electrical connection, start - up & load testing under the Base Bid.

C. Additive Alternate No. 3 - Prefabricated Metal Storage Building:

Base Bid: The purchase and installation of pre-engineered metal storage building is not included in Base Bid.

Additive: Add to the scope of work for the Contractor to furnish and install a prefabricated metal storage 10' x 12' with double doors (4'-0" W x 6'-8" H.) with electrical work as shown on construction documents (concrete pad and electrical stub out shall be included in base bid).

D. Additive Alternate No. 4 - Site Lighting:

Base Bid: Site lighting is not included in Base Bid.

Additive: Add to the scope of work to furnish labor & material to install underground electrical conductor feeds from circuit panel and install pole mounted site lighting system.

Note: All underground electrical conduits, stub outs with pull strings at the proposed light pole locations, including other related electrical work shall be included in Base Bid.

E. Additive Alternate No. 5 - Metal Standing Seam Roof:

Base Bid: Provide and install asphalt shingle roof system in Base Bid as per specifications Section 073110 and Drawings.

Additive: In lieu of asphalt shingle roof system, provide metal standing seam roof as per Specifications Section 074110 and Drawings.

F. Additive Alternate No. 6 – Secondary Access Drive:

Base Bid: Secondary access drive onto C.R. 579 with its associated access gates and its associated sidewalk is not included in Base Bid.

Additive: Provide secondary asphalt paved access drive onto C.R. 579 with its associated access gates and its sidewalk as shown on construction document.

END OF SECTION 010300

SECTION 010400 - PROJECT COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and supervisory requirements necessary for Project coordination including, but not necessarily limited to:
1. Coordination.
 2. Administration and supervisory personnel.
 3. General installation provisions.
 4. Cleaning and protection.
- B. Progress meetings, coordination meetings and pre-installation conferences are included in Section 01200 – Project Meetings.
- C. Requirements for the **CONTRACTOR's** Construction Schedule are included in Section 01310 – Bar Chart Schedule.

1.3 COORDINATION

- A. Coordination: Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection, and operation.
1. Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
 2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
1. Prepare similar memoranda for the **COUNTY** and **PROFESSIONAL** where coordination of their Work is required.

- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of schedules.
 2. Installation and removal of temporary facilities.
 3. Delivery and processing of submittals.
 4. Progress meetings.
 5. Project Close-out activities.
 6. Obtaining permits.

1.4 SUBMITTALS

- A. Coordination Drawings: Prepare and submit coordination drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, where limited space availability necessitates maximum utilization of space for efficient installation of different components, and where maximum effort is required to meet the requirements of the exhibits to be accommodated within the building.
1. Show the interrelationship of components shown on separate Shop Drawings.
 2. Indicate required installation sequences.
 3. Comply with requirements contained in SECTION 013000 - CONTRACTOR SUBMITTALS.
 4. Refer to Division-23 and Division-26 for specific coordination Drawing requirements for mechanical and electrical installations.
- B. Staff names: Within 15 days of Notice to Proceed with Work, submit a list of the **CONTRACTOR'S** principal staff assignments, including the project manager, superintendent, and other personnel in attendance at the site and at **CONTRACTOR'S** office; identify individuals, their duties and responsibilities; list their addresses and telephone numbers.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
1. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

2. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
3. Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.
4. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the **PROJECT MANAGER/PROFESSIONAL** for final decision.
5. Recheck measurements and dimensions before starting each installation.
6. Take into consideration the weather conditions and project status when installing each component to ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
7. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.
8. Mounting Heights: Where mounting heights are not indicated, refer mounting height decisions to the **PROJECT MANAGER/PROFESSIONAL** for final decision.

3.2 CLEANING AND PROTECTION

- A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration.
- B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, nor of existing buildings is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
 1. Excessive static or dynamic loading.
 2. Excessive internal or external pressures.
 3. Excessively high or low temperatures.
 4. Thermal shock.
 5. Excessively high or low humidity.
 6. Air contamination or pollution.
 7. Water.
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 9. Chemicals.
 10. Light.
 11. Radiation.
 12. Puncture.
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16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High speed operation.
21. Improper lubrication.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.
30. Vandalism.

END OF SECTION 010400

SECTION 010450 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. General provisions of Contract, including General Terms and Special Conditions.
- B. Refer to Division-23 and Division-26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.2 SECTION INCLUDES

- A. Administrative and procedural requirements for cutting and patching.

1.3 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:
 - 1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
 - 2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other visual elements.
 - 3. List products to be used and firms or entities that will perform Work.
 - 4. Indicate dates when cutting and patching is to be performed.
 - 5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
 - 6. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.
- B. Approval by the **PROJECT MANAGER** and **PROFESSIONAL** to proceed with cutting and patching does not waive the **PROJECT MANAGER** and **PROFESSIONAL'S** right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

1.4 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.
- B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related

components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

- C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the **PROJECT MANAGER** and **PROFESSIONAL'S** opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect.
- B. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding.
- B. Review areas of potential interference and conflict with trades involved. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

- A. Provide temporary support of Work to be cut.
- B. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

- A. Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- B. Cut existing construction using methods least likely to damage elements to be retained or adjoining construction.
 - 1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering, and chopping. Cut holes and slots neatly to size required with

minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
 4. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated, or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
- C. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
1. Inspect and test patched areas to demonstrate the integrity of the installation.
 2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance.
 4. Remove existing floor and wall coverings and replace with new materials if necessary to achieve uniform color and appearance.

3.4 **CLEANING**

- A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access.
- B. Remove completely paint, mortar, oils, putty, and items of similar nature.
- C. Thoroughly clean piping, conduit, and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION 010450

SECTION 010500 - FIELD ENGINEERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. General: This Section specifies administrative and procedural requirements for Field-Engineering services including, but not limited to, the following:
1. Land Survey Work,
 2. Civil-Engineering Services,
 3. Material Testing Services,
 4. System Testing Services.

1.3 SUBMITTALS

- A. Certificates: Submit a survey signed by a Land Surveyor or Professional Engineer showing the location and elevation of all buildings.
- B. Project Record Documents: Submit a record of Work performed and record survey data.
- C. Report: Submit a Test and Balance Report as indicated in the Contract Documents.

1.4 QUALITY ASSURANCE

- A. Engineer Qualifications: Engage an Engineer of the discipline required, licensed in the State of Florida to perform required Engineering Services.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify layout information shown on the Drawings before proceeding to lay out the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.
1. Do not change or relocate benchmarks or control points without prior written approval of **the COUNTY's** representative. Promptly report lost or destroyed reference points or

requirements to relocate reference points because of necessary changes in grades or locations.

2. Promptly replace lost or destroyed Project control points. Base replacements on the original survey control points.
- B. Establish and maintain a minimum of 2 permanent benchmarks on the site, referenced to data established by survey control points.
1. Record benchmark locations with horizontal and vertical data on Project Record Documents.
- C. Existing Utilities and Equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction.
1. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping.

3.2 PERFORMANCE

- A. Work from lines and levels established by the property survey. Establish benchmarks and markers to set lines and levels at each building. Do not scale Drawings to determine dimensions.
1. Advise entities engaged in construction activities of marked lines and levels provided for their use.
 2. As construction proceeds, check every major element for line, level, and plumb.
- B. Building Lines and Levels: Locate and lay out batter boards for structures, building foundations, column grids and locations, floor levels, and control lines and levels required for mechanical and electrical Work.
- C. Existing Utilities: Furnish information necessary to adjust, move, or relocate existing structures, utility poles, lines, services, or other appurtenances located in or affected by construction. Coordinate with local authorities having jurisdiction.

END OF SECTION 010500

SECTION 010700 - ABBREVIATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 GENERAL

- A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these specifications, the following acronyms or abbreviations which may appear in these specifications shall have the meanings indicated herein.

1.3 ABBREVIATIONS AND ACRONYMS

AAMA	Architectural Aluminum Manufacturers Association
AAR	Association of American Railroads
AASHTO	American Association of the State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
AFBMA	Anti-Friction Bearing Manufacturers Association, Inc.
AGA	American Gas Association
AGC	Associated General Contractors
AGMA	American Gear Manufacturers Association
AHAM	Association of Home Appliance Manufacturers
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ASA	Acoustical Society of America
ASAE	American Society of Agriculture Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society of Quality Control

ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturers Association
CBM	Certified Ballast Manufacturers
CEMA	Conveyors Equipment Manufacturers Association
CGA	Compressed Gas Association
CLPCA	California Lathing and Plastering Contractors Association
CLFMI	Chain Link Fence Manufacturers Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drill Manufacturers Association
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IME	Institute of Makers of Explosives
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
IOS	International Organization for Standardization
ITE	Institute of Traffic Engineers
FDOT	Florida Department of Transportation
MBMA	Metal Building Manufacturer's Association
MPTA	Mechanical Power Transmission of Association
MTI	Marine Testing Institute
NAAM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NCCLS	National Committee for Clinical Laboratory Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NLGI	National Lubricating Grease Institute
NMA	National Microfilm Association
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
RIS	Redwood Inspection Service
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturers Association
SAE	Society of Automotive Engineers

SAMA	Scientific Apparatus Makers Association
SSA	Swedish Standards Association
SMA	Screen Manufacturers Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPR	Simplified Practice Recommendation
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
SWFWMD	Southwest Florida Water Management District
TAPPI	Technical Association of the Pulp and Paper Industry
TFI	The Fertilizer Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 010700

SECTION 010950 – REFERENCE STANDARDS AND DEFINITIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 GENERAL

- A. Applicable Publications: Whenever in these specifications references are made to published specifications codes, standards, or other requirements, it shall be understood wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date of receipt of proposals shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the drawings shall be waived because of any provision of or omission from said standards or requirements.
- B. Assignment of Specialists: In certain instances, specification text requires (or implies) that specific Work is engaged for the performance of the Work. Such assignments shall be recognized as special requirements over which the **CONTRACTOR** has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work. They are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of Work is recognized as "expert" for the indicated construction process or operations. Nevertheless, the final responsibility for fulfillment of the entire set of Contract requirements remains with the **CONTRACTOR**.

1.3 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. Indicated: The term "indicated" refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
- C. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the **PROJECT MANAGER**," "requested by the **PROJECT MANAGER**," and similar phrases.
- D. Approved: Means "approved by **PROJECT MANAGER** and/or **PROFESSIONAL**."
- E. Regulations: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
- G. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, Working to dimension, finishing, curing, protecting, cleaning, and similar operations."

Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."

- I. Installer: An "Installer" is the Subcontractor, or an entity engaged by the CONTRACTOR either as an employee, subcontractor, or contractor of lower tier for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
1. The term "experienced," when used with the term "Installer," means having a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
- a. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades persons of the corresponding generic name.
- b. Assignment of Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and assignments are requirements over which the **CONTRACTOR** has no choice or option. Nevertheless, the ultimate responsibility for fulfilling Contract requirements remains with the **CONTRACTOR**.
- 1) This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.
- J. Project Site is the space available to the **CONTRACTOR** for performance of construction activities, either exclusively or in conjunction with others performing other Work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- K. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.4 SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 33-Division format.
- B. Specification Content: This Specification uses certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
1. Abbreviated Language: Language used in Specifications and other Contract Documents is the abbreviated type. Words and meanings shall be interpreted as appropriate. Words that are implied but not stated shall be interpreted as the sense required. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and the context of the Contract Documents so indicates.

2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the **CONTRACTOR**. At certain locations in the text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by the **CONTRACTOR** or by others when so noted.

The words "shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.

1.5 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with the permit requirements in effect as of the date of the issuance of the Building Permit, issued by the Hillsborough County Construction Services Division.
- C. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.
 1. Where copies of standards are needed for performance of a required construction activity, the **CONTRACTOR** shall obtain copies directly from the publication source.
- D. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.

1.6 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the specifications, all Work specified herein shall conform to or exceed the requirements of all applicable codes, and the applicable requirements of such documents are not in conflict with the requirements of these specifications nor applicable codes.
- B. References herein to "Building Code," "Code" or "FBC" shall mean the Florida Building Code. The latest edition of the code, as approved and used by the local agency, as of the date of award, and as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.
- C. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the **PROJECT MANAGER** and **PROFESSIONAL** for clarification and directions prior to ordering or providing any materials or labor. The **CONTRACTOR** shall bid the most stringent requirements.
- D. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations, including all changes and amendments thereto.
- E. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations, including all changes and amendments thereto.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 010950

SECTION 012000 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 PRE-CONSTRUCTION CONFERENCE

- A. In accordance with the **AGREEMENT**, prior to the commencement of any construction Work, a pre-construction conference will be held at a mutually agreed time and place. The conference may be attended by:
1. Responsible officer of **CONTRACTOR** and superintendent assigned to the project
 2. Principal subcontractors
 3. Representatives of principal suppliers and manufacturers as appropriate
 4. Professional
 5. Project Manager
 6. Representatives of the **COUNTY**
 7. Governmental representatives as appropriate
 8. Others as requested by **CONTRACTOR**, **COUNTY**, Professional, or Project Manager.
- B. Unless previously submitted to Project Manager, **CONTRACTOR** shall bring the following to the conference:
1. Preliminary Schedule of Values.
 2. Preliminary Schedule of shop drawings and other submittals.
 3. A list of all permits and licenses the **CONTRACTOR** shall obtain indicating the agency required to grant the permit and the expected date of submittal of permit and the required date for receipt of the permit.
 4. A Bar Chart Schedule, in accordance with Section 01310.
 5. Product information as required by the Special Conditions.
 6. List of major subcontractors.
- C. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda will include as a minimum:
1. **CONTRACTOR'S** schedules
 2. Transmittal, review, and distribution of **CONTRACTOR'S** submittals
 3. Processing applications for payment
 4. Maintaining record documents
 5. Critical work sequencing
 6. Field decisions and changes
 7. Use of premises, office and storage areas, security, housekeeping, and **COUNTY's** needs
 8. Major equipment deliveries and priorities
 9. **CONTRACTOR'S** assignments for safety and first aid
- D. **THE CONTRACTOR** shall preside at the conference and will arrange to keep the minutes and distribute them to all persons in attendance.

1.2 PROGRESS MEETINGS

- A. **THE CONTRACTOR** shall schedule and conduct regular progress meetings as required by progress of the WORK, at a minimum to occur once every two weeks. **CONTRACTOR**, Project Manager, Professional, and subcontractors active on the site as required shall be represented at each meeting. **CONTRACTOR** may request attendance by representatives of its suppliers, manufacturers, and other subcontractors.

- B. The **PROFESSIONAL** shall keep the minutes and distribute the minutes to the **COUNTY**, **CONTRACTOR**, and others. The purpose of the meetings will be to review the progress of the **WORK**, maintain coordination of efforts, discuss changes in scheduling, and resolve problems which may develop.

1.3 COORDINATION/PRE-INSTALLATION MEETINGS

- A. In addition to progress meetings, **CONTRACTOR** is to hold coordination meetings and pre-installation conferences with personnel and subcontractors to assure coordination of work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012000

SECTION 013000 - CONTRACTOR SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 GENERAL

- A. Wherever submittals are required hereunder, all such **CONTRACTOR's** submittals shall be submitted to the Professional or as designated by the Project Manager.
- B. Prior to the issuance of the Notice to Proceed with Construction, or any Limited Notice to Proceed with Construction, the **CONTRACTOR** shall submit the following, but not limited to:

1. Bar Chart Schedule
2. Schedule of Values
3. Schedule of Shop Drawings, Materials and Equipment, Product Data Submittals

- C. Within fifteen (15) days after issuance of the Notice to Proceed with Work but no later than the Pre-Construction Conference, the **CONTRACTOR** shall submit the following including, but not limited to:

Revised Bar Chart Schedule when required by the Project Manager

Project Schedule Detail as requested by the Project Manager

Revised Schedule of Values when required by the Project Manager

List of **CONTRACTOR'S** staff assignments.

List of subcontractors and vendors

List of all permits and licenses the **CONTRACTOR** has (or will) obtained, including copies of all permits.

- D. Miscellaneous Submittals: The **CONTRACTOR** shall provide other additional submittals as required by the AGREEMENT and Specifications.

1.3 CONTRACTOR'S SUBMITTAL REQUIREMENTS

- A. Bar Chart Schedule: The Bar Chart Schedule shall be in conformance with and incorporate the milestones indicated in the **AGREEMENT**. It shall be in conformance with Section 01310 of the Specifications. The **CONTRACTOR** shall submit 4 copies of the Bar Chart Schedule.

Project Schedule Detail: The **CONTRACTOR**, when requested by the Project Manager, shall provide additional detail explaining the sequence of activities in the Bar Chart

Schedule and the relationship of these activities to the Schedule of Values. The **CONTRACTOR** shall submit four (4) copies of the Project Schedule Detail.

- C. Schedule of Values: The Schedule of Values shall be prepared, submitted, reviewed, monitored and approved in accordance with this and paragraph 5.12 of the General Terms and Conditions.

The Schedule of Values shall represent a fair and reasonable distribution of costs. The sum of the items listed in the Schedule of Values shall equal the Contract lump sum price. Overhead and profit shall not be listed as separate items in the Schedule but shall be distributed evenly through all line items. Each line item shall reflect the actual cost of the Work described (including overhead and profit). General Conditions and Special Conditions such as mobilization, bonds, insurance, field office, may be listed separately if proper cost can be justified. Cost of home office cannot be listed separately and cannot be included in General Conditions or Special Conditions.

The **CONTRACTOR** shall submit a balanced Schedule of Values which does not provide for over-payment to the **CONTRACTOR** on activities which would be performed first. Each line item shall reflect the actual cost of the Work described. The Schedule shall be revised and resubmitted until acceptable to the Professional/Project Manager. Once the Schedule has been approved by the Professional and Project Manager, the **COUNTY** reserves the right throughout the Contract (at its option), to require that the **CONTRACTOR** maintain a particular price contained in the Schedule of Values, for the purpose of negotiating Change Orders and Allowance Authorization and Contingency Releases.

The Schedule of Values shall be on 8-1/2" x 14" format, in conformance with the **COUNTY**'s standard Payment Application form.

The **CONTRACTOR** shall submit four (4) copies of the Final Schedule of Values.

- D. List of **CONTRACTOR**'S Staff Assignments: The **CONTRACTOR** shall submit a list indicating all field and office staff personnel scheduled to work on this Project.

1. The Project Manager shall be advised in writing of any removal or reassignment of any "key personnel" identified in the Proposal.

- E. Schedule of Shop Drawings/Shop Drawing Submittal

1. Schedules: In compliance with Section 01600 - Material and Equipment, the **CONTRACTOR** shall prepare a Schedule of Submittals.
 - a. Coordinate the Submittal Schedule with the list of subcontractors, Schedule of Values, and the list of products as well as the Bar Chart Schedule.
 - b. Prepare the Schedule in chronological order. Provide the following information:

Scheduled date for the first submittal,
Related Section number,
Submittal category (Shop Drawings, Product Data, or Samples),
Name of the subcontractor,
Description of the part of the Work covered,
Requested date for the Professional's final release or approval.

2. Distribution/Copies: Wherever called for in the Contract Documents or where required by the Project Manager, the **CONTRACTOR** shall furnish to the Professional for review an electronic computer file copy and two (2) hard prints for the **COUNTY'S** use.
3. Definitions/Milestones: The term "submittal" as used herein shall be as defined in the **AGREEMENT** and shall be understood to include but not be limited to the following: detailed design calculations, shop drawings, fabrication and installation drawings, erection drawings, lists, graphs, operating instructions, catalog sheets, data sheets, samples, schedules, reports and similar items. Unless otherwise required, said submittals shall be submitted to the Professional at a time sufficiently early enough to allow review of same and to accommodate the rate of construction progress required under the **AGREEMENT**. Any submittal which is not complete or does not provide the level of detail outlined in the Specifications and required by the Professional, shall not be considered acceptable for review and may be returned for re-submittal. Should any submittal be a part of any scheduled milestone and considered to be unacceptable by the **COUNTY**, the appropriate milestone shall be considered as not having been met until a complete and properly detailed submittal is received.
4. Submittal Procedures: All submittals shall be prepared using the following procedures:
 - a. All shop drawings or other submittals shall be accompanied by a standard submittal transmittal form as appended to this section. The submittal will be returned for re-submittal if not accompanied by such a form or if all applicable items on the form are not completed. Ultimate responsibility for the accuracy and completeness of the information contained in the submittal shall remain with the **CONTRACTOR**.
 - b. Normally, a separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole.
 - 1) Each submittal shall be prepared in compliance with the **AGREEMENT** and stamped with an approved shop drawing stamp.
 - c. Except as may otherwise be provided herein, each submittal will be returned to the **CONTRACTOR** through the Professional, with its comments noted thereon, within a reasonable number of calendar days following their receipt. It is considered reasonable that the **CONTRACTOR** shall make a complete and acceptable submittal to the Professional. The **COUNTY** reserves the right to withhold monies due to the **CONTRACTOR** to cover additional costs of review when multiple submittals are required due to **CONTRACTOR'S** failure to comply with the specifications.
 - d. If the submittal is returned to the **CONTRACTOR** marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.

- 1) If the submittal is returned to the **CONTRACTOR** marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will not be required.
 - 2) If the submittal is returned to the **CONTRACTOR** marked "AMEND - RESUBMIT," the **CONTRACTOR** shall revise said submittal and shall resubmit revised submittal to the Professional.
 - 3) If the submittal is returned to the **CONTRACTOR** marked "REJECTED - RESUBMIT," the **CONTRACTOR** shall revise said submittal and shall resubmit said revised submittal to the PROFESSIONAL.
- e. All **CONTRACTOR** submittals shall be carefully reviewed by an authorized representative of the **CONTRACTOR** prior to submission to the Professional. Each submittal shall be dated, signed, and certified by the **CONTRACTOR** as being correct. No consideration for review by the Professional of any **CONTRACTOR** submittals will be made for any items which have not been so certified by the **CONTRACTOR**. All non-certified submittals will be returned to the **CONTRACTOR** without action taken by the Professional, and any delays caused thereby shall be the total responsibility of the **CONTRACTOR**.
- f. Fabrication of an item shall not commence before the Professional has reviewed the pertinent submittals and returned copies to the **CONTRACTOR** marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Revisions indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.
- g. The **COUNTY** reserves the right to review all shop drawings for conformance with the contract documents and to reject said shop drawings, if found not to be in conformance.
- h. The Professional's review of **CONTRACTOR** submittals shall not relieve the **CONTRACTOR** of the entire responsibility for the correctness of details and dimensions. The **CONTRACTOR** shall assume all responsibility and risk for any misfits due to any errors in **CONTRACTOR** submittals. Any fabrication or other work performed in advance of the receipt of approved submittals shall be entirely at the **CONTRACTOR'S** risk and expense. The **CONTRACTOR** shall be responsible for the dimensions and the design of adequate connections and details.
- i. The Professional reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
- j. The Professional will review architectural related submittals within 15 days, and engineering related submittals within 21 days.

F. Project Data Submittal:

1. Whenever, in the final specifications, samples are required, the **CONTRACTOR** shall submit not less than three (3) samples of each item or material to the Professional for approval. Additional samples, if requested by the Professional or Project Manager, shall be provided at no additional cost to the **COUNTY**.
2. Samples, as required herein, shall be submitted for approval a minimum of fifteen (15) working days prior to ordering such material for delivery to the jobsite and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the Work.
3. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and manufacturer's names for identification.
4. Unless otherwise specified, all colors and textures of specified items will be selected by the PROFESSIONAL from the manufacturer's standard colors and product lines and approved by the **COUNTY**.
5. **CONTRACTOR** shall submit all color-related items within 45 days of Notice to proceed. Professional will prepare color board for **COUNTY** approval within 30 days after receipt of all color submittals.

G. Technical Manuals:

1. The **CONTRACTOR** shall furnish to the Professional/Project Manager three (3) identical sets of technical manuals and one electronic computer file set. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, three-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches. A table of contents shall be provided which indicates all equipment in the technical manuals.
2. The technical manuals shall include for each item of mechanical and electrical equipment:
 - a. Complete operating instructions, including location of controls, special tools or other equipment required, related instrumentation, and other equipment needed for operation.
 - b. Lubrication schedules, including the lubricant SAE grade and type, temperature range of lubricants, and frequency of required lubrication.
 - c. Preventive maintenance procedures and schedules.
 - d. Parts lists by generic title and identification number complete with exploded views of each assembly.
 - e. Disassembly and re-assembly instructions.
 - f. Name and location of nearest supplier and spare parts warehouse.
 - g. Recommended troubleshooting and start-up procedures.

- h. Reproducible prints and electronic files of the record drawings, including diagrams and schematics, as required by Section 01720 of these specifications.

H. List of Permits:

1. The **CONTRACTOR** shall submit four (4) copies of the list of permits. The list shall indicate all permits and licenses required for the permitting, construction and operation of the Project.
2. The list shall include names of regulatory agencies, permit numbers, status of permits and licenses.
3. The **CONTRACTOR** shall also submit copies of all required permits and licenses with the list.

I. List of Subcontractors and Vendors:

1. The **CONTRACTOR** shall submit four (4) copies of the list of subcontractors and vendors providing labor, equipment, and materials for the Project.
2. The list shall include company name, address, telephone and fax numbers, and contact person. Annotate which subcontractor/vendor is an SBE/MBE.
3. The list shall be formatted on 8 1/2" x 11" paper and follow the CSI format.

1.4 MISCELLANEOUS SUBMITTALS

- A. In addition to the specific submittal requirements indicated above, other miscellaneous submittals are required, as defined in the **AGREEMENT**, Special Conditions and Divisions 1-16 of the Specifications. These include, but are not limited to, the following:

1. Warranties
2. Workmanship Bonds
3. Field Records
4. Maintenance Manuals
5. Inspection and Test Reports
6. Close-out Submittals

- B. Progress Reports: If required by the Project Manager, a progress report shall be furnished to the Professional and Project Manager with each Application for Payment. If the Work falls behind schedule, **CONTRACTOR** shall submit additional progress reports at such intervals as Project Manager may request.

1. Each progress report shall include sufficient narrative to describe any current and anticipated delaying factors, their effect on the construction schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to Project Manager, must be substantiated with satisfactory evidence.

2. Each progress report shall include a list of the activities completed with their actual start and completion dates, a list of the activities currently in progress, and the number of working days required to complete each.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 013000

SECTION 01 31 00 - BAR CHART SCHEDULE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 THE REQUIREMENT

- A. A bar chart schedule shall be employed by the **CONTRACTOR** for the planning and scheduling of all work required under the Contract Documents.
- B. If requested by the Project Manager, the bar chart schedule shall also reflect **CONTRACTOR's** estimated cash flow projections for the entire Project.

1.3 SUBMITTAL PROCEDURES

A. Submittal Requirements

1. The **CONTRACTOR** shall submit 4 copies of the Bar Chart Schedule and 1 electronic copy.
2. Schedule will be submitted on a standard drawing sheet, size 24 inches x 36 inches.
3. The time scale (horizontal) shall be in weeks. The activities shall be listed on the left-hand side (vertical).
4. Activities shall be broken down into sufficient detail to show most work activities. The listing from top to bottom shall be in a logical manner of which the work will be accomplished. Space shall be provided between activities or within bars to allow for marking of actual progress.
5. A written narrative of the planning logic along with a description of work and quantities included in each activity shall be submitted with the bar chart schedule.

B. Time of Submittals

1. Within ten (10) days after Notice of Award, but no later than Pre-Construction Meeting Day, **CONTRACTOR** shall submit a bar chart schedule for review by the Project Manager and Professional. The schedule submitted shall indicate a project completion date the same as the contract completion date indicated in the **AGREEMENT**.
2. A copy of the schedule, clearly showing progress made shall be submitted on a two- or four-week basis depending on the duration of the project and reporting time agreed to in the pre-construction meeting. The timing of the submission of schedules is at the discretion of the Project Manager.

C. Acceptance

1. The bar chart schedule, when accepted by the Project Manager and Professional, shall constitute the project work schedule unless a revised schedule is required due to one or more of the following:
 - a. Substantial changes in the work scope.
 - b. A change in contract time.
 - c. Changes in the **CONTRACTOR's** progress of the WORK.
 - d. Delinquency by Contractor that requires a recovery schedule.
2. Such acceptance will neither impose on Project Manager or County responsibility for the progress or scheduling of the Work, nor relieve **CONTRACTOR** from full responsibility therefore.

D. Schedule Revisions

1. Upon the request of the Project Manager, **CONTRACTOR** shall provide a revised bar chart schedule if, at any time, the Project Manager considers the completion date to be in jeopardy because of activities behind schedule. The revised bar chart schedule must show how **CONTRACTOR** intends to accomplish the Work to meet the contractual completion dates. The form and method employed by **CONTRACTOR** shall be the same as for the original bar chart schedule.
2. Upon approval of a change order modifying the work scope, the approved change shall be reflected in the next scheduled submittal by **CONTRACTOR**.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01310

SECTION 01 35 00 – HAZARDOUS MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

- A. The use of hazardous materials is to be in accordance with Florida Statutes 235.3215.
- B. Definitions: "Hazardous material" is hereby defined as being any substance that could cause a health risk if used in an inappropriate way or contrary to manufacturer's recommendations. Hazardous materials include all materials listed on the "Florida Substance List" and further defined and regulated by Chapter 381-30 of the Florida Administrative Code (Rules of the Department of Labor and Employment Security), as published by the Department of Labor and Employment Security, Division of Safety. Copies of this list are available on request from the Division of Safety by calling 1-800-367-4378.
- C. Submittals: Submit a Material Safety Data Sheet to the Architect for each hazardous material proposed for use on the project. The Architect shall submit all "MSDS's" to the Owner for review and approval. All "MSDS's" are to be submitted within 30 days of the start of construction, but in no case not less than 30 days prior to the scheduled use of that product. No material containing a hazardous substance shall be used on the project without an approved MSDS.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXECUTION

- A. If upon review, the COUNTY disapproves of the hazardous material being proposed for use, the CONTRACTOR shall find an acceptable substitution at no additional cost to the COUNTY and resubmit an "MSDS" to the PROFESSIONAL for review and approval.
- B. If the proposed hazardous material is approved for use, the CONTRACTOR shall notify the COUNTY no less than 14 days prior to the scheduled use of that product so that proper measures can be taken to ensure the safety of building occupants.
- C. Hazardous materials that are approved for use on the project must be installed in accordance with manufacturer's instructions and other applicable regulations. Printed manufacturer's instructions pertaining to the use of the product are to be made available to the PROFESSIONAL for review.
- D. MSDS's are to be made available upon request to all individuals who may come in contact with the material.

END OF SECTION 01 35 00

SECTION 014000 - QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality control services.
- B. Quality control services include inspections, tests, and related actions, including reports performed by **CONTRACTOR**, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by **PROJECT MANAGER** or **PROFESSIONAL**.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve **CONTRACTOR** of responsibility for compliance with Contract Document requirements.
- D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.
 - 1. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures.
 - a. Inspections, test, and related actions specified are not intended to limit the **CONTRACTOR'S** quality control procedures that facilitate compliance with Contract Document requirements.
 - b. Requirements for the **CONTRACTOR** to provide quality control services required by the **COUNTY, PROFESSIONAL** or authorities having jurisdiction are not limited by provisions of this Section.

1.3 RESPONSIBILITIES

- A. **CONTRACTOR** Responsibilities: **CONTRACTOR** shall provide inspections, tests, and other quality

control services specified elsewhere in the Contract Documents or required by authorities having jurisdiction.

Costs for these services are included in the GMCP.

1. Where individual Sections specifically indicate that certain portions, tests, and other quality control services are required, the **CONTRACTOR** shall employ and pay for a qualified independent testing agency to perform quality control services. Cost for these services must be included in the Guaranteed Maximum Construction Price.
- B. Retesting: The **CONTRACTOR** is responsible for retesting where results of inspections, tests, or other quality control services prove unsatisfactory and indicate noncompliance with Contract Document requirements.
- C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to:
 1. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
 2. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
 3. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
 4. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
 5. Security and protection of samples and test equipment at the Project site.
- D. Duties of the Testing Agency: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Specifications Sections shall cooperate with the **COUNTY**, the **CONTRACTOR**, and the **PROFESSIONAL** in performance of its duties. The testing agency shall provide qualified personnel to perform required inspections and tests.
 1. The agency shall notify the **PROJECT MANAGER**, **PROFESSIONAL** and **CONTRACTOR** promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.

3. The agency shall notify the **PROJECT MANAGER, PROFESSIONAL** and **CONTRACTOR** promptly of irregularities or deficiencies observed in the Work during performance of its services.
- E. Coordination: The **CONTRACTOR** and each agency engaged to perform inspections, tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay.
In addition, the **CONTRACTOR** and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
 1. The **CONTRACTOR** is responsible for scheduling times for inspections, tests, taking samples and similar activities.

1.4 SUBMITTALS

- A. All certified written reports of each inspection, test or similar service performed by the independent testing agency shall be submitted to the **COUNTY** and **PROFESSIONAL** in duplicate.
 1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
- B. Report Data: Provide written reports of each inspection, test, or similar service.
 1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
 2. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making the inspection or test.
 - f. Designation of the Work and test method.
 - g. Identification of product and Specification Section.
 - h. Complete inspection or test data.
 - i. Test results and an interpretation of test results.
 - j. Ambient conditions at the time of sample taking and testing.
 - k. Comments or **PROFESSIONAL** opinion as to whether inspected or tested Work complies with Contract Document requirements.
 - l. Name and signature of laboratory inspector.
 - m. Recommendations on retesting.

3. The **COUNTY** reserves the right to engage and pay for the services of an independent agency to perform additional testing at any time, beyond that required of the **CONTRACTOR**.

1.5 QUALITY ASSURANCE

Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are pre-qualified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes.
- B. Protect construction exposed by or for quality control service activities and protect repaired construction.
- C. Repair and protection is **CONTRACTOR'S** responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 014000

SECTION 014100 - MATERIALS TESTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division-1 Specification Sections and related Technical Sections, apply to this Section.

1.2 PROCEDURE

- A. Testing Agency: independent testing agency shall be provided by the **CONTRACTOR** to inspect and test the materials and methods of construction as specified for compliance with the specification requirements of the Contract Documents.

1.3 QUALIFICATIONS OF TESTING AGENCY

- A. The Testing Agency selected shall meet the basic requirements of ASTM E329 "Standard of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction."
- B. The Testing Agency selected shall meet "Recommended Requirements for Independent Laboratory Qualification," latest edition, as published by the American Council of Independent Laboratories.
- C. Testing machines shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the National Bureau of Standards or accepted values of natural physical constants.
- D. Tests and inspection shall be conducted in accordance with specified requirements, and if not specified, in accordance with the applicable standards of the American Society for Testing and Materials or other recognized and accepted authorities in the field.

1.4 AUTHORITIES AND DUTIES OF THE TESTING AGENCY

- A. Reviewing Drawings and Specifications: The Testing Agency shall obtain and review the project plans and specifications. The Agency shall attend site meetings to coordinate materials inspection and testing requirements with the planned construction schedule.
- B. Notification of Deficiencies in the Work: The agency shall notify the Project Manager, Professional and **CONTRACTOR** first by telephone and then in writing of observed irregularities and deficiencies of the work and other conditions not in compliance with the requirements of the Contract Documents.
- C. Reports: The agency shall send copies of test and inspection reports to the following parties:
1. 1 copy to the Project Manager or his representative
 2. 3 copies to Professional
 3. 1 copy to the Supplier of the material tested
- D. Limitation of Authority: The Testing Agency is not authorized to revoke, alter, relax, enlarge upon, or release any requirements of the Specifications or to approve or accept any portion of the Work or to perform any construction work.

1.5 PAYMENT OF TESTING AGENCY

- A. The **CONTRACTOR** shall pay for the Testing Agency services for testing of materials for compliance with the requirements of the Contract Documents.
- B. The **CONTRACTOR** shall also pay for testing and re-testing of materials that do not comply with the requirements of the Contract Documents and all other items as specified in these Specifications.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 SCOPE OF WORK

- A. This Section specifies materials testing for earthwork, reinforcing steel, concrete, masonry mortar and grout testing and structural steel.

3.2 EARTHWORK

- A. Quality Control Testing Required During Construction
 - 1. Inspection of Subgrade and Fill: The Testing Agency shall inspect and approve the following subgrades and fill layers before further construction work is performed thereon:
 - a. Building slab subgrade, Paved areas subgrade, and/or Foundation wall backfill: As recommended by the Geotechnical Report enclosed within the Specifications.
 - 2. Field Density Tests: Field density tests shall be performed according to ASTM D1556 "Density of Soil in Place by the Sand Core Method," ASTM D2167 "Density of Soil in Place by the Rubber Balloon Method" or ASTM D2922 "Density of Soil and Soil Aggregate in Place by Nuclear Methods" as applicable.
 - 3. Acceptance Criteria: The results of field density tests by the Testing Agency will be considered satisfactory if the average of any three consecutive tests has a value not greater than 2 percent below the required density.
 - 4. Report copies: The results of field density tests certified by Testing Agency shall be distributed to the Project Manager and Professional.
 - 5. Additional testing: If reports by the Testing Agency indicate field densities lower than specified above, additional tests will be run by the Testing Agency with at least the frequencies scheduled above on recompacted fill and/or natural subgrade. The costs of such test shall be borne by the **CONTRACTOR**.
 - 6. Earthwork testing as set forth in the Geotechnical Report and Division 2.
- B. Inspection by the Testing Agency: The **CONTRACTOR** shall provide a Testing Agency to perform inspection service for the following listed items prior to pouring and placing foundation concrete:

1. Spread (Dug) Footing Subgrade: Such inspection shall verify that field conditions are consistent with soil report test results and that the foundation is being installed in the proper soil strata at the proper elevation. The Testing Agency's written field inspection reports shall be distributed to the Professional and Project Manager.

3.3 REINFORCING STEEL

- A. Visual Inspection: The Testing Agency shall inspect the reinforcing steel to determine the following:
 1. The bars should be free from injurious defects and shall have a workman-like finish.
 2. Deformations shall be of the proper sizes, shapes, and spacing as detailed in ASTM A-615.
 3. The bars shall not have excessive rust and/or pelting.
 4. The bars shall not have any unusual twists or bends

3.4 CONCRETE MATERIALS AND POURED IN PLACE CONCRETE

- A. Concrete Mix Designs
 1. The **CONTRACTOR** shall submit for approval concrete mix designs for each class of concrete indicated on the drawings and in the Specifications. The **CONTRACTOR** shall not begin work until the applicable mix design has been approved.
 2. Required types of concrete and compressive strengths shall be indicated on the Drawings and Specifications.
 3. Admixtures
 - a. Quantities of admixtures to be used shall be in strict accordance with the manufacturer's instructions.
 - b. Admixtures containing chloride ions shall not be used in pre-stressed concrete, in concrete containing galvanized or aluminum embedments, or in metal deck floors or roofs.
- B. Concrete Test Cylinders by Testing Agency
 1. Molding and Testing: Cylinders for strength tests shall be molded and Laboratory cured in accordance with ASTM C31 "Method of Making and Curing Concrete Test Cylinders in the Field" and tested in accordance with ASTM C39 "Method of Testing for Compressive Strength of Cylindrical Concrete Specimens."
 2. Field Samples: Field samples for strength tests shall be taken in accordance with ASTM C172 "Method of Sampling Fresh Concrete."
 3. Frequency of Testing: Each set of test cylinders shall consist of a minimum of four standard test cylinders. A set of test cylinders shall be made according to the guidelines set forth in Section 03300.

4. Transporting cylinders: The Testing Agency shall be responsible for transporting the cylinders to the laboratory in a protected environment such that no damage or ill effect will occur to the concrete cylinders.

5. **Information on concrete test reports: as set forth in Section 03300.**

C. Evaluation and Acceptance of Concrete: as set forth in Section 03300.

D. Investigation of Low Strength Concrete Test Results

1. Field tests: The Testing Agency shall perform nondestructive field tests of the concrete in question using appropriate methods and report the results in the same manner as for cylinder test reports.
2. Strengthening of the structure or demolition: if the structural adequacy of the affected portion of the structure remains in doubt, the **CONTRACTOR** shall strengthen the structure by appropriate means approved by the Professional or demolish and rebuild the structure.
3. Cost of investigations for low strength concrete: the costs of all investigations of low strength concrete shall be borne by the **CONTRACTOR**.

- E. Job site inspection: Verify that all concrete being placed meets job specifications. Report concrete not meeting the specified requirements and immediately notify the owner.

- F. Causes for rejection of concrete: The **CONTRACTOR** shall reject all concrete delivered to the site for any of the following reasons:

1. Wrong class of concrete (incorrect mix design number).
2. Concrete with temperatures exceeding 95°F may not be placed in the structure.
3. Slumps outside the limits specified in the mix designs.
4. Excessive age. Concrete shall be discharged within 90 minutes of plant departure or before it begins to set if sooner than 90 minutes, unless approved by the laboratory job inspector or other duly appointed representative.

- G. Concrete Batch Trip Tickets: All concrete batch trip tickets shall be collected and retained by the **CONTRACTOR**. All tickets shall contain the information specified in ASTM C94. Each ticket shall also show the amount of water that may be added in the field for the entire batch that will not exceed the specified water cement ratio for the design mix.

3.5 MASONRY

A. Mortar Tests

1. Mortar cube tests shall be required for loadbearing masonry construction only for the purpose of measuring uniformity of field batching.
2. Compressive Strength Test: Tests shall be run according to the requirements of ASTM C780 "Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry."

B. Grout Tests

1. Grout prism tests shall be required for all grout used in masonry construction.
2. Compressive Strength Test: Specimens shall be 3 1/2" x 3 1/2" x 7" or 3" x 3" x 6" cast in molds with a flat nonabsorbent base and masonry units having the same moisture condition as those being laid forming the sides of the specimens. Specimens shall be capped according to ASTM C617 and tested according to ASTM C39.
3. Frequency of testing: Four grout prisms shall be made for each 30 cubic yards of grout but not less than one set for each day's operation. An additional set should be made whenever the grout mix is changed.

3.6 STRUCTURAL STEEL

A. Structural Steel Connections:

1. Testing and inspection of bolted connections in accordance with RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
2. Visual inspection and testing of welded connections in accordance with AWS D1.1, using inspections procedures as recommended in project specifications.
3. Test and inspection of shop-welded shear connectors in accordance with AWS D1.1 for stud welding, using procedures as recommended in project specifications.
4. Examination of the structural steel for straightness and alignment, and examination of fabricated pieces for proper cleaning and painting.

B. Steel Joists:

1. Visual inspection and testing of field welds in accordance with AWS D1.1/D1.1M, using procedures as recommended in project specifications.
2. Visual inspection and testing of bolted connections in accordance with RCSC's "Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts".

C. Steel Deck:

1. Visual inspection of field welds.
2. Inspection and testing of shear connector welds in accordance with AWS D1.1 for stud welding, using procedures as recommended in project specifications.

D. Field Reports:

1. The independent testing company shall provide field reports to the Owner, Professional and **Contractor**.
2. **Contractor** shall provide corrective action until Work is accepted as compliant.
3. Cost of re-testing and re-inspection to be borne by **Contractor**.

END OF SECTION 014100

SECTION 015000 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions, and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes requirements for construction facilities and temporary controls, including temporary utilities, support facilities, and security and protection.
- B. Temporary utilities include, but are not limited to:
1. Water service and distribution.
 2. Temporary electric power and light.
 3. Ventilation.
 4. Telephone service.
 5. Sanitary facilities.
 6. Storm and sanitary sewer.
- C. Support facilities include, but are not limited to:
1. Field offices and storage sheds.
 2. Temporary roads and paving.
 3. Dewatering and drains.
 4. Temporary enclosures.
 5. Temporary project identification signs and bulletin boards.
 6. Waste disposal services.
 7. Rodent and pest control.
 8. Construction aids and miscellaneous services and facilities.
- D. Security and protection facilities include, but are not limited to:
1. Temporary fire protection.
 2. Barricades, warning signs, and lights.
 3. Environmental protection.

1.3 QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:
1. Building code requirements.
 2. Health and safety regulations.
 3. Utility company regulations.
 4. Police, fire department, and rescue squad rules.

5. Environmental protection regulations.
- B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."
 1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 "National Electric Code."
- C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.4 PROJECT CONDITIONS

- A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the **COUNTY**, change over from use of temporary service to use of permanent service.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Maintain facilities clean and neat on a regular basis. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site. Comply with Section 01710 - Final Cleaning for administrative and procedural requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials. If acceptable to the **COUNTY**, the **CONTRACTOR** may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.
- B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."
- C. Water: Provide potable water approved by local health authorities.

2.2 EQUIPMENT

- A. General: Provide new equipment. If acceptable to the **COUNTY**, the **CONTRACTOR** may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.
- B. Temporary Offices: **CONTRACTOR** shall provide a well-lighted site field office for use by his superintendent and for construction meetings for the duration of the WORK. A construction trailer or other temporary facility shall be air-conditioned and adequately furnished for drawing layout and construction meetings. At a minimum, the furnishings shall include standard desk, 8-10 person conference table, plan table plan rack, file cabinet and chairs.

- C. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- D. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers, or a combination of extinguishers of NFPA-recommended classes for the exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Engage the appropriate local utility company to apply for service, obtain meter and install temporary service or connect to existing service. Where company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.
- B. Water Service: Provide water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.
- C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnects, automatic ground-fault interrupters, and main distribution switchgear.
- D. Temporary Lighting: When overhead floor or roof deck has been installed, provide temporary lighting with local switching.
- E. Temporary Telephones: Provide temporary telephone service throughout the construction period for personnel engaged in construction activities. **CONTRACTOR'S** key personnel must be available for communication for duration of Work by telephone, cellular phone, and facsimile machine.
- F. Toilets: Install self-contained toilet units.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Locate storage sheds, field offices, and other temporary construction and support facilities for easy access and removal.
 - 1. Maintain support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the **COUNTY**.
- B. Dewatering and Drains: Maintain the site, excavations, and construction free of water.
- C. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.
- D. Project Identification and Temporary Signs: Prepare project identification and other signs of size indicated. Do not permit installation of unauthorized signs.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the **COUNTY**.
- B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations."
- C. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.
- D. Enclosure Fence: Temporary fencing has already been installed across the front of the fire station site. Fence and gate are to remain until final fence and gate installation are completed. The **CONTRACTOR** is to provide their own locks on the temporary gates.
- E. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by high winds, rain and similar elements.
- C. Termination and Removal: Remove each temporary facility when the need has ended, when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
- D. At Substantial Completion, clean, and renovate permanent facilities used during the construction period including, but not limited to, the following:
 - 1. Replace air filters and clean inside of ductwork and housings.
 - 2. Replace significantly worn parts and parts subject to unusual operating conditions.
 - 3. Replace lamps burned out or noticeably dimmed by hours of use.
 - 4. Clean HVAC coils, etc.

END OF SECTION 015000

SECTION 015050 - MOBILIZATION

PART 1 - GENERAL

1.1 DEFINITION AND SCOPE

A. Mobilization shall include the obtaining of necessary permits, insurance, and bonds; moving onto the site of all plant and equipment; temporary buildings, temporary utilities and other construction facilities; all as required for the proper performance and completion of the Work. Mobilization shall include, but not be limited to, the following principal items:

1. Install temporary construction power, wiring, and lighting facilities.
2. Establish fire protection plan and safety program.
3. Secure construction water supply.
4. Provide on-site sanitary facilities and potable water facilities as required.
5. Arrange for **CONTRACTOR'S** field office.
6. Submit all required insurance certificates and bonds.
7. Obtain all required permits.
8. Post all OSHA, EPA, Department of Labor, and all other required notices.
9. Have **CONTRACTOR'S** superintendent at the job site full time.
10. Submit a detailed construction schedule acceptable to the **COUNTY** as specified.
11. Erect project construction signs as specified.
12. Submit a finalized schedule of values of the WORK in the **COUNTY'S** approved format.
13. Submit a finalized schedule of submittals.

1.2 PROJECT SIGNS

A. **CONTRACTOR** shall furnish and install a project construction sign as indicated in Section 01510. **THE CONTRACTOR** shall provide all erection materials. Signs shall be erected in a location as directed by the **PROJECT MANAGER**. Sign shall be braced to keep it in a plumb position for the construction duration. The **CONTRACTOR** shall remove and dispose of the sign when directed by the **PROJECT MANAGER**.

1.3 PAYMENT FOR MOBILIZATION

- A. The **CONTRACTOR**'s attention is directed to the condition that no payment for mobilization, or any part thereof, will be approved for payment under the Contract until all mobilization items have been completed as specified.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 015050

SECTION 01 5100 – PROJECT CONSTRUCTION SIGN

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications and the Sections included under Division 1, General Requirements and References are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. This Section includes the requirements for furnishing and installing the Project Construction Sign, including the following:

1. Project Construction Sign Products and Materials.
2. Location of Project Construction Sign.
3. Execution and Installation Schedule of Project Construction Sign.

1.3 SUBMITTALS

- A. Submit Project Construction Signage Shop Drawing:
1. **COUNTY** will provide graphics for the Project Construction Sign electronically.
 2. Provide one signage (1) proof for COUNTYS review and approval..

1.4 QUALITY ASSURANCE

- A. Code Requirement: Project sign shall comply with all applicable Codes, including wind load recommendations and requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Image360, 8611 N. Dale Mabry, Tampa, FL 33614, 8130960-0633, or equal.

2.2 MATERIALS

- A. Construct Project sign of the following:
1. Sign Faces: 4 ft. W x 6 ft. T x 3MM Thick Metal.
 - a. Single sided
 - b. Reflective Print

- c. Layout graphics shall be provided by the County.
- d. See Sample Sign Exhibit A, this specification section .

2. Posts:

- a. Size of Posts: As required per Florida Building Code wind load requirements.
- b. Material: Not less than two (2) posts 4" x 4" x 120" Pressure Treated wood.

3. Fasteners:

- a. Use fasteners that are zinc-coated to inhibit rust.
- b. Number of Fasteners: As required to meet Florida Building Code wind load requirements.

2.3 FABRICATION

- A. Project construction sign shall be fabricated off-site and brought to the Project site ready for installation.

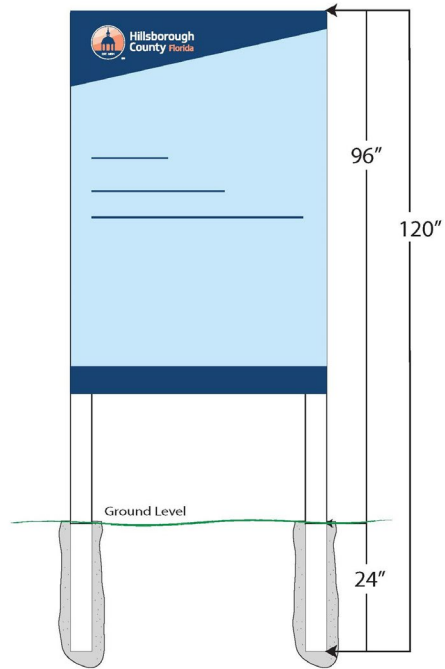
3 PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine the areas and conditions where the project construction
- B. General: Install project construction sign at a location that is visible to the public, which typically is adjacent to the entrance drive of the Project site and approved by the **COUNTY**.
- C. Install the Project Construction Sign within 10 business days after Notice to Proceed, it shall remain in-place until final completion has been issued, or otherwise directed by the **COUNTY**.
- D. Bottom face of the Project Construction Sign shall be a minimum of 2 ft. above grade, per Sign Installation Exhibit B, this specification section.
- E. Provide protection during installation as necessary to prevent damage to adjacent surfaces and finishes.



Sign Exhibit A



Sign Installation Exhibit B

END OF SECTION 01 5100

SECTION 015300 – BARRICADES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

Drawings and General Provisions of the Contract, including General Terms and Special Conditions and Division 1 Specification Sections apply to work of this Section.

1.2 DESCRIPTION OF WORK

A. Scope:

1. Erect and maintain all barricades required by the drawings, specification and by regulatory authorities and agencies.
2. Types of barricades shall include but not be limited to:
 - a. Street barricades
 - b. Safety barricades
 - c. Protective barricades.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies

1. Comply with duly constituted regulatory authorities and agencies in matters pertaining to
 - a. Permitting
 - b. Safety precautions
 - c. Barricades
 - d. Lighting of barricades
 - e. Protection of environmental matters
2. Maintain safety among persons employed in accordance with the standards set by the OCCUPATIONAL SAFETY AND HEALTH ACT (latest adoption). The **COUNTY** and **PROFESSIONAL** shall be held harmless for any accident, injury or any other incident resulting from non-compliance with these standards.

PART 2 – PRODUCTS

2.1 MATERIALS

- ##### A. Lumber for barricades: Sound, thoroughly seasoned, dressed 4 sides, free from excessive warp, kiln dried with maximum moisture content of 15%, of nominal sized, and complying with PS-20.
1. Lumber for barricades used in the closing of streets and for use in streets or where vehicular traffic regularly occurs: No. 2 Southern Pine or equivalent (to be painted).
 2. Lumber used for safety barricades: Same as for closing of streets.

3. Lumber for protective barricades: No. 2 common Southern Pine pressure treated with water borne preservative complying with the American Wood Preservers Bureau (not to be painted).
- B. Paint for barricades scheduled to be painted: Alkyd chlorinated paraffin-plasticizing oil finishing system type:
 1. Primer: Exterior wood primer, 1 coat, and 4.0 wet mil thickness.
 2. Finish: Exterior house and trim paint, 2 coats, 3.2 wet mil thickness.
 3. Colors: To comply with regulatory agency requirements; otherwise such shall be 6" side alternating diagonal stripes equivalent to the following Sherwin-Williams colors:

Yellow-orange	BK-221
White	BW-64
 4. The following manufacturers are approved, subject to compliance with these specifications:

Sherwin-Williams	P.P.G. Industries
Benjamin-Moore	Glidden
Martin-Semour	Devoe
Porter	Rust-O-Leum
 5. Comply with manufacturer's recommendations for application.

PART 3 – EXECUTION

1.1 CONSTRUCTION

- A. Construct barricades in sound, well-braced manner in accordance with best practice.
- B. Suspend a sandbag from beneath each free standing barricade device adding weight to prevent blow over.

1.2 BARRICADE SCHEDULE/TYPES

- A. Safety Barricades
 1. Safety barricades as herein defined shall be those used to warn or to guard vehicles and human beings against injury or damage against dangerous conditions such as excavations, overhead items subject to falling, ongoing construction work or other dangerous situations. The CONTRACTOR shall maintain and service such safety barricades in good repair until such condition or situation no longer exists.
 2. Provide and maintain daily, yellow blinker lights on safety barricades from dusk to dawn each night until the barricade is removed.
- B. Protective Barricades
 1. Protective barricades as herein defined shall be those used to protect from damage by vehicle or other device, all trees, shrubs, bushes, manholes, drainage structures or other items which are scheduled or intended to remain permanently in place and which are subject to damage. Such protective barricades shall perimeter or otherwise

guard such items to be protected by 6 feet of clearance on all sides. Vertical posts of such protective barricades shall be embedded in the earth to a depth of 3 feet minimum and shall extend to a height 4 feet above existing grade. Such protective barricades shall remain in place and Contractor shall maintain and service such in good repair until all work is complete or until directed by the Architect to remove such, whichever is earlier.

2. Protective barricades need not be provided with reflectors or blinking lights nor need such protective barricades be painted.
3. Protective barricades shall be constructed of 2 x 6 nominal pressure treated lumber.

END OF SECTION 015300

SECTION 015600 - TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 EXPLOSIVES AND BLASTING

- A. The use of explosives on the Work will not be permitted unless approved by the Project Manager.

1.3 DUST ABATEMENT

- A. **CONTRACTOR** shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary and as directed by Project Manager to prevent **CONTRACTOR'S** operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals or causing a nuisance to persons living in or occupying buildings in the vicinity. **CONTRACTOR** shall be responsible for any damage resulting from any dust originating from **CONTRACTOR'S** operations.

1.4 RUBBISH CONTROL

- A. During the progress of the Work, **CONTRACTOR** shall keep the site of the Work and other areas used by **CONTRACTOR** in a neat and clean condition and free from any accumulation of rubbish. The **CONTRACTOR** shall establish regular intervals of collection and disposal of all rubbish and waste materials of any nature occurring at the Work site. **CONTRACTOR** shall also keep haul roads free from dirt, rubbish, and unnecessary obstructions resulting from **CONTRACTOR'S** operations. The trash collection schedule shall be approved by the Project Manager. Equipment and material storage shall be confined to areas approved by the Project Manager and Professional. Disposal of all rubbish and surplus materials shall be off the site of construction at the **CONTRACTOR'S** expense, all in accordance with local codes and ordinances governing locations and methods of disposal, in conformance with all applicable safety laws, and to the particular requirements of Subpart H, Section 1926.252 of the OSHA Standards for Construction.

1.5 SANITATION

- A. Toilet Facilities: Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Sub-part D, Section 1926.51 of the OSHA Standards for Construction.
- B. Sanitary and Other Organic Wastes: The **CONTRACTOR** shall establish a regular collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the **CONTRACTOR** or organic material wastes from any other source related to the **CONTRACTOR's** operations shall be disposed of away from the site in a manner satisfactory to the **PROJECT MANAGER** and in accordance with all laws and regulations pertaining thereto. Disposal of all such wastes shall be at the **CONTRACTOR's** expense.

1.6 CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether defoliant, soil sterilizer, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of either the US Environmental Protection Agency or the US Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

1.7 TEMPORARY DRAINAGE PROVISIONS

- A. **THE CONTRACTOR** shall provide for the drainage of stormwater and such water as may be applied or discharged on the site in performance of the Work. Drainage facilities shall be adequate to prevent damage to the Work, the site, and adjacent property.

1.8 EROSION CONTROL

- A. **THE CONTRACTOR** shall prevent erosion of soil on the site and adjacent property resulting from its construction activities. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operation that will disturb the natural protection.

1.9 POLLUTION CONTROL

- A. **CONTRACTOR** shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris, or other substances will be permitted to enter sanitary sewers or storm drains.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 015600

SECTION 016000 - MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements governing the **CONTRACTOR's** selection of products for use in the Project.
- B. Standards: Refer to Section "Reference Standards and Definitions" for applicability of industry standards to products specified.
- C. Administrative procedures for handling requests for substitutions made after award of the Contract are included under Sections "Substitutions" and "Substitute Materials and Equipment."

1.3 DEFINITIONS

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well recognized meanings in the construction industry.
 - 1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - a. "Named Products" are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
 - b. "Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside of the United States and its possessions; or produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.
 - 2. "Materials" are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
 - 3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.4 **QUALITY ASSURANCE**

- A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.
- B. Compatibility of Options: When the **CONTRACTOR** is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
1. The **CONTRACTOR** is responsible for providing products and construction methods that are compatible with products and construction methods of other Work.
 2. If a dispute arises over concurrently selectable, but incompatible products, the Professional will determine which products shall be retained and which are incompatible and must be replaced.
- C. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:
1. No available domestic product complies with the Contract Documents.
 2. Domestic products that comply with Contract Document are only available at prices or terms that are substantially higher than foreign products that also comply with the Contract Documents.
- D. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.
1. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.
 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface, which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.

1.5 **PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.
3. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.
5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
7. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.
 1. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.
 2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations. Procedures governing product selection include the following:
 1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.
 2. Semi-proprietary Specification Requirements: Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.

- a. Where products or manufacturers are specified by name, accompanied by the term "or equal" or "or approved equal," comply with the Contract Document provisions to obtain approval for use of an unnamed product.
3. Non-Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the **CONTRACTOR** to use of these products only, the **CONTRACTOR** may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.
 - a. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.
6. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.
7. Visual Matching: Where Specifications require matching an established Sample, the Project Manager's decision will be final on whether a proposed product matches satisfactorily.
 - a. Where no product available within the specified category matches satisfactorily and also complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category, or for noncompliance with specified requirements.
8. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Project Manager/Professional will select the color, pattern and texture from the product line selected.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
 - 1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 016000

SECTION 01 61 00 – FLORIDA PRODUCT APPROVAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes Florida Building Code Product Approval requirements.
- B. Related Sections include the following:
1. Division 1 Section "Materials and Equipment" for overall product requirements.
- C. Product approval numbers for required building components used as the basis for design are shown on the drawings.

1.3 QUALITY ASSURANCE

- A. Comply with Product Approval F.A.C. Rule 9B-72.080. For each product installed in the building envelope, either:
1. Provide to the Building Department the applicable Product Approval Numbers, or
 2. Provide certification acceptable to the Building Department that products installed conform to the Florida Building Code 2023 8TH Edition.
- B. The list of building components for the required products and manufacturers is as follows:
1. Exterior doors.
 2. Exterior Openings
 3. Panel Walls
 4. Roofing Products
 5. Shutters, if specified.
 6. Skylights, if specified
 7. Structural Components
 8. Other products as applicable, comprising a building's envelope introduced as a result of new technology.
- C. The list shown above is not comprehensive. No effort was made to list each and every possible aperture in the building envelope. The **CONTRACTOR** shall check to see what aperture(s) apply and furnish the applicable Product Approval Number as issued by the State of Florida Department of Community Affairs (DCA) or required certification.

- D. Refer to structural engineering drawings for wind design criteria including wind speed, risk category, exposure category, and wind born debris region information.

1.4 SUBMITTALS

- A. Submit the applicable Product Approval Number for above paragraph 1.3C for each product varying from those listed on the drawings as the basis of design and for any other required component of the building envelope.
- B. For any component not having a Product Approval Number supply the following:
1. Engineering Analysis and Calculations:
 - (a) For installed products indicated to comply with design loads, include structural analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 61 00

SECTION 016310 - SUBSTITUTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

1.3 DEFINITIONS

- A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the **CONTRACTOR** after award of the Contract are considered to be requests for substitutions. Substitutions will be considered by the **COUNTY** as a special request. The following are not considered to be requests for substitutions:
1. Substitutions requested during the bidding period, and accepted by Addendum prior to award of the Contract, are included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
 2. Revisions to the Contract Documents requested by the **COUNTY**.
 3. The **CONTRACTOR'S** determination of and compliance with governing regulations and orders issued by governing authorities.
- C. If the Specifications provides for options of products and allows "or equal" products, **CONTRACTOR** must follow the substitution process stated herein and in the general Conditions for obtaining approval of such "equal" products.
1. **CONTRACTOR** must submit all requests to consider "or equal" products within 30 days of Notice to Proceed With Work. Otherwise, one of the specified options must be used.

1.4 SUBMITTALS

- A. Substitution Request Submittal: If the **CONTRACTOR** wishes to furnish or use a proposed substitute after the award of the Agreement, it shall within thirty (30) days after Notice to Proceed make written application to the **PROFESSIONAL** for consideration of such substitute, certifying in writing that the proposed substitute will perform adequately the duties imposed by the general design, be similar and of equal substance or quality to that specified, and be suited to the same use and capable of performing the same function as that specified. No substitute shall be ordered or installed without the prior written approval of the **PROJECT MANAGER**, who shall be the sole judge of acceptability. Requests received more than 30 days after Notice to Proceed with Work date will not be considered.

B. **CONTRACTOR** shall:

1. Submit copies of each request for substitution for consideration to Professional and Project Manager.
2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide itemized estimate of all costs (increase or decrease) that may result directly or indirectly from acceptance of such substitute, including costs of redesign, delays, maintenance, and claims of other contractors affected by the resulting
3. Provide complete documentation showing compliance with the requirements for substitutions.
4. If necessary, the **COUNTY** will request additional information or documentation for evaluation.

C. Approval of any change in costs or schedule as a result of acceptance of the substitute by the **PROJECT MANAGER** shall be by Change Order.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Conditions: At the **COUNTY'S** option, the **COUNTY** may receive and consider the **CONTRACTOR'S** request for substitution when one or more of the following conditions are satisfied. If the following conditions are not satisfied, as determined by the **COUNTY**, the request(s) will be returned to the **CONTRACTOR** without action except to record noncompliance with these requirements.

1. Extensive revisions to the Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of the Contract Documents.
3. The request is timely, fully documented, and properly submitted.
4. The specified product or method of construction cannot be provided within the Contract Time. The **COUNTY** will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
5. The request is directly related to an "or-equal" clause or similar language in the Contract Documents.
6. The requested substitution offers the **COUNTY** a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the **COUNTY** must assume. The **CONTRACTOR** will assume responsibilities for redesign and evaluation services, increased cost of other construction, and any other cost associated with the substitution.
7. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the **CONTRACTOR** certifies that the substitution will overcome the incompatibility.
9. The specified product or method of construction cannot be coordinated with other materials and where the **CONTRACTOR** certifies that the proposed substitution can be coordinated.

10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the **CONTRACTOR** certifies that the proposed substitution provides the required warranty.
 11. Where a proposed substitution involves more than one prime Contractor and/or Subcontractor, each shall cooperate with the other Contractor and/or Subcontractor involved to coordinate the Work, provide uniformity and consistency, and assure compatibility of products.
- B. **CONTRACTOR** is specifically prohibited from using the shop drawing process as a vehicle for Substitutions. The **CONTRACTOR'S** submittal and the **COUNTY'S** acceptance of Shop Drawings, Product Data, or Samples for construction activities not complying with the Contract Documents do not constitute an acceptable or valid request for substitution, nor do they constitute approval.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 016310

SECTION 017000 - CONTRACT COMPLETION, START-UP, AND CLOSEOUT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the **CONTRACT**, including General Terms and Special Conditions and other Division-1 Specification sections apply to this section.

1.02 COMPLETION PROCEDURES

- A. Substantial Completion is as defined in the General Conditions. When the **CONTRACTOR** believes Substantial Completion has been achieved, it shall certify in writing to the **PROJECT MANAGER** that the Project is Substantially Complete in accordance with the Contract Documents and request the **PROJECT MANAGER** to inspect the Work and to issue a Certificate of Substantial Completion. Prior to making such a request, the **CONTRACTOR** must:
1. Complete all WORK necessary for the safe, proper and complete use or operation of the Project as intended, including obtaining occupancy permits, operating testing and certificates and similar releases.
 2. Provide training to the **COUNTY'S** maintenance agency.
 3. Prepare a **CONTRACTOR**-generated punch list, i.e., a list of all items required to render the Project complete satisfactory and acceptable, for submission with the request for inspection and issuance of a certificate of Substantial Completion.
 4. Submit to the **PROFESSIONAL** and **PROJECT MANAGER** for acceptance and approval the following close-out documentation:
 - a. One-year Warranty letter from sub-contractors and General Contractor.
 - b. All extended warranties in accordance with the specifications. (All Warranties shall commence on the date of Substantial Completion.)
 - c. As-built drawings, a complete set of reproducible drawings as well as electronic files (ACAD) indicating changes to the project noted with clouds.
 - d. All required test reports, including a commissioning report relating specifically to the HVAC system and supplied by the HVAC equipment vendor.
 - e. Three sets of approved shop drawings and one set of electronic files.
 - f. Three bound 3-ring binders with one set each of manufacturer's information on equipment and materials, maintenance information and warranties. Additionally provide one set of electronic files with this same information. **CONTRACTOR** to provide technical support for one year after final completion in addition to the one (1) year General Contractor's warranty.
- B. Upon receipt of the request from the **CONTRACTOR**, the **PROJECT MANAGER**, assisted by the **PROFESSIONAL**, and other **COUNTY** personnel, as appropriate, shall review the request, the Work and the **CONTRACTOR** - generated Punch List to determine whether the Work is ready for Substantial Completion inspection. If this review fails to support Substantial Completion inspection, the Project Manager shall so notify the **CONTRACTOR** citing the reasons for rejection. If the **PROJECT MANAGER** and **PROFESSIONAL** determine the Work is ready for Substantial Completion inspection; the following procedures will be followed:

1. The **PROJECT MANAGER** will within a reasonable time schedule and conduct inspection(s) of the Work with the **PROFESSIONAL**, other **COUNTY** personnel as required, and the **CONTRACTOR** for the purpose of formally reviewing the status of completion of the Work, the readiness of the Project for use and the **CONTRACTOR**-generated punch list. A copy of the **CONTRACTOR**-generated punch list will be provided to all participants and any additional items noted during the inspection will be added to the list. The **PROJECT MANAGER**, the **PROFESSIONAL**, their representatives and other **COUNTY** representatives will review the Work and the **CONTRACTOR**-generated punch list to assure all deficiencies are noted on a final document (the "Punch List"). The Punch List must include all items required to render the Project complete, satisfactory, and acceptable. If the **PROJECT MANAGER** and **CONTRACTOR** disagree on whether an item belongs on the Punch List, the **PROJECT MANAGER** has the final say on whether the item is included or not.
 2. If, upon completion of the inspection(s) the **COUNTY** does not consider the Project Substantially Complete, the **PROJECT MANAGER** will notify the **CONTRACTOR** in writing giving reasons why the Project is not Substantially Complete.
 3. If, upon completion of the inspection(s), the **COUNTY** considers the Project Substantially Complete, the **PROJECT MANAGER** shall prepare a Certificate of Substantial Completion to establish the date for Substantial Completion as the date of the completed inspection(s). The Certificate of Substantial Completion shall be approved by the **COUNTY** upon the signature of both the Project Manager and the Professional and shall be issued to the **CONTRACTOR**. This Certificate shall fix the date of Substantial Completion.
- C. Final Completion will be deemed to have occurred when all Work is completed including the following:
1. All final Construction Review (punch list) items have been corrected, signed off by the **CONTRACTOR**, the Project Manager and the Professional, and demonstrated to the **COUNTY** during a final inspection.
 2. All record drawings, operations and maintenance manuals, warranties and guarantees have been reviewed and accepted.
 3. The **PROFESSIONAL** and **PROJECT MANAGER** have reviewed and accepted the following documentation:
 - a. Consent of Surety to Final Payment.
 - b. Contractor's Affidavit of Payment of Debts and Claims.
 - c. Sub-contractor Waiver of Liens.
 - d. One year Warranty letter from subcontractors and General Contractor.
 - e. All extended warranties in accordance with the specifications. (All Warranties shall commence on the date of Substantial Completion.)
 - f. As-built drawings, a complete set of drawings as well as electronic files (ACAD) indicating changes to the project noted with clouds and annotations indicating equipment changes.
 - g. All required test reports.
 - h. One set of approved shop drawings.

- i. Three bound 3-ring binders with one set each of manufacturer's information on equipment and materials, maintenance information and warranties. Additionally provide one set of electronic files with this same information. **CONTRACTOR** to provide technical support for one year after final completion in addition to the one (1) year General Contractor's warranty.
4. Demobilization and site cleanup are complete.
5. The Project Manager and Professional have issued a Certificate of Final Completion.
6. The requirements specified under the Contract have been met.
7. All facilities and/or equipment have been properly demonstrated to be functioning as required and all training has been completed.

1.03 BENEFICIAL OCCUPANCY

- A. Beneficial Occupancy will normally not occur before Substantial Completion but can occur for a discrete element of a project when desired by the **COUNTY**. When Beneficial Occupancy is requested, the same procedure specified in 1.02(b) above will be used.

1.04 START-UP PROCEDURES

- A. The **CONTRACTOR** is responsible for the complete test, check out, start-up and commissioning of all elements of the project. The **CONTRACTOR** shall verify these activities through daily inspection reports, test records, on-site vendor inspections and certifications and by other appropriate means. The test and start-up requirements below are complementary to those specified elsewhere in the Contract Documents.
 1. Component test and check out is the verification that each component of the WORK is in compliance with the Contract Documents and is ready to perform its intended function.
 2. Sub-system test and start-up is the verification that a discrete group of related components is functioning as intended within itself and is ready to perform its intended function in the overall system.
 3. System test and start-up is the operation and verification that all related components and sub-systems are functioning as intended and are ready for final commissioning and operation.
 4. Commissioning is placing a complete system or project into service.
- B. The **CONTRACTOR** shall conduct all tests, check out and start-up requirements specified in the Contract Documents and provide documentation of same to the **COUNTY** prior to commissioning. Where vendor on-site inspections are required prior to or during start-up, the **CONTRACTOR** shall require vendor to provide a written statement that the installation and check out is complete and proper and that the item(s) are ready for start-up and/or commissioning.
- C. The **CONTRACTOR** must inspect, approve installation, and supervise the start-up of the HVAC system.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 INSTRUCTION OF THE COUNTY'S USER AGENCIES

- A. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the **COUNTY'S** personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
1. Maintenance manuals.
 2. Record documents.
 3. Spare parts and materials.
 4. Tools.
 5. Lubricants.
 6. Fuels.
 7. Identification systems.
 8. Control sequences.
 9. Hazards.
 10. Cleaning.
 11. Warranties and guarantees.
 12. As part of instruction for operating equipment, demonstrate the following procedures:
 - a. Start-up of all Systems.
 - b. Shut-down of all Systems.
 - c. Emergency operations/including emergency generator.
 - d. Mechanical Systems Controls
 - e. Electrical/Lighting Systems Controls
 - f. Noise and vibration adjustments.
 - g. Safety procedures.
 - h. Economy and efficiency adjustments.
 - i. Effective energy utilization.

3.2 CLOSEOUT PROCEDURES

- A. The **PROJECT MANAGER, PROFESSIONAL** and **CONTRACTOR** shall meet and resolve all outstanding issues including, but not limited to:
1. Claims and adjustments for time to costs
 2. Outstanding, unused allowance
 3. Procedures for handling warranty issues
- B. A Final Change Order shall be processed if required. Final payment and close out procedures shall comply with **Article 15**, Payment and Completion, in the General Terms & Conditions and all other requirements of the Contract Documents.

END OF SECTION 017000

SECTION 017100 - FINAL CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General Terms and Special Conditions and other Division-1 Specifications Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for final cleaning at Substantial Completion.
- B. Environmental Requirements: Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and anti-pollution regulations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: General cleaning during construction is required by the General Conditions.
- B. Cleaning: Employ qualified, experienced workers or a qualified professional cleaner for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
- C. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
 - 1. Remove labels that are not permanent labels.
 - 2. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision- obscuring materials. Replace chipped or broken glass and other damaged transparent materials.

3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces; wet mop ceramic and porcelain tile.
 4. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
 5. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.
 6. Provide new, clean air filters for all equipment and systems controlling air within the facility prior to the issuance of Substantial & Final Completion.
- D. Pest Control: Engage an experienced exterminator to make a final inspection, and rid the Project of rodents, insects, and other pests.
- E. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.
- F. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. **DO NOT** burn waste materials. **DO NOT** bury debris or excess materials on the **COUNTY'S** property. **DO NOT** discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.
1. Where extra materials of value remaining after completion of associated Work have become the **COUNTY'S** property, arrange for disposition of these materials as directed.

END OF SECTION 017100

SECTION 01 72 00 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for Project Record Documents as follows:
 - 1. Record Drawings and specifications
 - 2. Operating and Maintenance documents
 - 3. Miscellaneous Records
 - 4. Instruction of the **COUNTY** operating personnel in operation and maintenance of building systems and equipment.
 - B. Specific record copy requirements that expand requirements of this Section are included in the individual Sections of Divisions-2 through -33.
 - C. General project close-out requirements are included in Section 01 70 00 "Project Close-Out."
 - D. General requirements for submittal of Project Record Documents are included in Section 01 30 00 "Contractor Submittals."
 - E. Maintenance of Documents and Samples: Store record documents and Samples in the field office apart from **CONTRACTOR's** Documents used for construction. Do not permit Project Record Documents to be used for construction purposes. Maintain record documents in good order, and in a clean, dry, legible condition. Always make documents and Samples available for inspection by the Project Manager and Professional.
- #### 1.3 RECORD DOCUMENTS
- A. General: Do not use record documents for construction purposes; protect from deterioration and lock in a secure, fire-resistant location; provide access to record documents for the Project Manager's review during normal working hours.
 - 1. Responsibility for Markup: Where feasible, the individual or entity who obtained record data, whether the individual or entity is the installer, subcontractor, or similar entity, is required to prepare the mark-up on Record Drawings.
 - 2. Accurately record information in an understandable drawing technique.
 - 3. Record data as soon as possible after it has been obtained. In the case of concealed installations, record and check the mark-up prior to concealment.

- B. Record Drawings: Maintain a clean, undamaged set of blue or black line whiteprints of Construction Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Construction Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
- C. Record Specifications: Maintain one complete copy of the Construction Specifications, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Product Data.
- D. Record Product Data: Maintain one copy of each Product Data submittal. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site and from the manufacturer's installation instructions and recommendations. Give particular attention to concealed products and portions of the Work, which cannot otherwise be readily discerned later by direct observation. Indicate related Change Orders and mark-up of record drawings and Specifications.
 - 1. Record Sample Submitted: Immediately prior to the date or dates of Substantial Completion, the **CONTRACTOR** will meet at the site with User Agency personnel to determine which of the submitted Samples that have been maintained during progress of the Work are to be transmitted to User Agency for record purposes. Comply with delivery to User's Sample storage area.
- E. Miscellaneous Record Submittals: Refer to Section 01300 "Contractor Submittals" for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Professional/Project Manager for the **COUNTY'S** records.
- F. Maintenance Manuals: Organize operating and maintenance data into suitable sets of manageable size as described in Section 01 72 50 "Operating and Maintenance Data".
- G. Electronic files: The **COUNTY** will furnish a compact disc containing the Project's electronic files to the **CONTRACTOR**. The **CONTRACTOR** shall transfer all information on the marked record drawings set to electronic files utilizing a program and format acceptable to the County. The transfer of information must be provided by a professional drafter. The Professional shall review and approve the resulting electronic record. A printed copy will then be furnished with the approved electronic record (on compact disc) by the **CONTRACTOR** to the **COUNTY**.
- H. Mark-up Procedure for documents: During the construction period, maintain a set of blue- or black-line white-prints of Final Construction Drawings, and one copy of the Final Construction

Specifications, including addenda and modifications issued for Project Record Document purposes. Mark the Drawings to indicate the actual installation where the installation varies appreciably from the installation shown originally. Give particular attention to information on concealed elements, which would be difficult to identify or measure and record later. Mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in Specifications and modifications issued. Note related Project Record Drawing information, where applicable. Give particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.

1. All deviations must be highlighted on the record drawings using a "Cloud". If any revisions to the original plans required a Change Order, the "Cloud" shall include the Change Order number.

I. Minimum Record Drawings Standards: All as-built conditions must be noted as follows:

1. Mark new information that is important to the **COUNTY**, but was not shown on Contract Drawings or Shop Drawings.
2. Note related Change Order numbers where applicable.
3. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
4. Locate valves, fittings, plugs, caps and taps for pipelines.
5. Provide invert elevation of all drainage and sewage services.
6. Note limits, dimensions, and depth of concrete encasement, casing pipe, and sheeting.
7. Note horizontal and vertical locations of other public and private utilities when they are encountered during construction.
8. Indicate size, type, depth, location, and limits of any abandoned pipe that is part of design. Include type of abandonment (i.e. end plug, mortar filled, etc.).
9. Roadway: Provide elevations of all roadway vertical control points and terminations of curb returns.
10. Building: All dimensional changes larger than 1/4". Material and substitution changes from specified materials. Changes to design and room layouts. Structural modifications. Electrical panelboard and equipment changes including corrected circuit numbers as they appear on panelboard directories. Corrected motor horsepower or full load amperages. Mechanical equipment, changes in duct work, layout, and equipment.
11. Mark actual manufacturer, trade name, catalog, and supplier of each product changes made by change order or field order.

1.4 SITE RECORD DOCUMENTS

- A. The **CONTRACTOR** shall also submit Final Site "As-Built" plans, for project site, as electronic files and in paper copy signed by a Florida Registered Land Surveyor, according to the following requirements:

1. All site horizontal and vertical controls, grade, elevations for roadways and walks, all drainage related systems and ponds, mitigation areas, building locations and finish floor

elevations, site amenities locations, elevations and associated landscaping as previously requested.

- B. **CONTRACTOR** shall require the Registered Land Surveyor to make periodic inspections of the work during construction to verify that the work remains in conformance with the Plans and Specifications.

1.5 OTHER SUBMITTALS REQUIREMENTS

- A. Record Copies: Immediately after the inspection for Certification of Substantial Completion, review completed marked-up record Drawings with the Project Manager and Professional. When authorized, prepare a full set of corrected drawings and electronic files of **CONTRACTOR'S** Marked up Drawings.

1. Incorporate changes and additional information previously marked on record print sets as described above. Erase, redraw, and add details and notations where applicable. Identify and date each Drawing; include the printed designation "PROJECT RECORD DRAWINGS" in a prominent location on each Drawing.
2. Incorporate changes in CADD files of Final Construction Documents.
3. The **CONTRACTOR** is responsible for printing and distributing copies.
4. Review of Copies: Before copying and distributing, submit corrected transparencies and the original marked-up prints to the Professional for review. When acceptable, the **CONTRACTOR** will initial and date each copy, indicating acceptance of general scope of changes and additional information recorded, and of the quality of drafting. The copies and the original marked-up prints will be reviewed by the Professional and then returned to the **CONTRACTOR** for organizing into sets, printing, binding and final submittal.

- B. Distribution: Copies and Distribution: After completing the preparation of record drawings, print 3 blue-line or black-line white prints of each Drawing, whether or not changes and additional information were recorded. Organize the copies into manageable sets. Bind each set with durable paper cover sheets, with appropriate identification, including titles, dates and other information on cover sheets.

1. Organize and bind original marked-up set of prints and specifications that were maintained during the construction period in the same manner.
2. Organize record transparencies into sets matching the print sets. Place these sets in durable tube-type Drawing containers with end caps. Mark the end cap of each container with suitable identification.
3. Submit the marked-up record set, specifications, transparencies, 3 copy sets, and CD to the PROJECT MANAGER for **COUNTY'S** records. The **CONTRACTOR** will retain one copy set.

1.6 OPERATING RECORDS AND MAINTENANCE MANUAL SUBMITTAL

- A. Submit, three (3) copies of required records and maintenance, operating, warranty manuals after issuance of the Certificate of Substantial Completion, but prior to the Final Completion (to include electronic files). Manuals shall be submitted and prepared in compliance with Section 01 30 00 "Contractor Submittals" and Sections 01 73 00 "Operating and Maintenance Data".

1.7 MISCELLANEOUS RECORD SUBMITTALS

- A. Refer to other Specification Sections for miscellaneous record- keeping requirements and submittals in connection with various construction activities. Immediately prior to Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Submit to the Professional for the **COUNTY'S** records, if applicable, the following:
1. Categories of requirements resulting in miscellaneous records include, but are not limited to the following, if applicable:
 - a. Field records on excavations and foundations.
 - b. Field records on underground construction and similar Work.
 - c. Authorized measurements utilizing unit prices or allowances.
 - d. Certifications received in lieu of labels on bulk products.
 - e. Batch mixing and bulk delivery records.
 - f. Testing and qualification of tradesmen.
 - g. Documented qualification of installation firms.
 - h. Load and performance testing.
 - i. Inspections and certifications by governing authorities.
 - j. Leakage and water-penetration tests.
 - k. Fire resistance and flame spread test results.
 - l. Final inspection and correction procedures.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 RECORDING

- A. Post changes and modifications to the Documents as they occur. Do not wait until the end of the Project. The Project Manager and Professional will periodically review record documents to assure compliance with this requirement.

END OF SECTION 01 72 00

SECTION 01 72 50 - OPERATING AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions and other Division-1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for operating and maintenance manuals including the following:
 - 1. Preparation and submittal of operating and maintenance manuals for building operating systems or equipment.
 - 2. Preparation and submittal of instruction manuals covering the care, preservation and maintenance of architectural products and finishes.
 - 3. Instruction to the **COUNTY** operating personnel, in operation and maintenance of building systems and equipment.
- B. Special operating and maintenance data requirements for specific pieces of equipment or building operating systems are included in the appropriate Sections of Divisions-2 through -33.
- C. Preparation of Shop Drawings and Product Data are included in Section 01 30 00 "Construction Manager Submittals".
- D. General close-out requirements are included in Section 01 70 00 "Project Close-out."
- E. General requirements for submittal of Project Record Documents are included in Section 01 72 00 "Project Record Documents" and Section 01 30 00 "Contractor Submittals".

1.3 QUALITY ASSURANCE

- A. Maintenance Manual Preparation: In preparation of Maintenance Manuals, use qualified personnel thoroughly trained and experienced in operation and maintenance of the equipment or system involved.
 - 1. Where written instructions are required, use personnel skilled in technical writing to the extent necessary for communication of essential data.
 - 2. Where Drawings or diagrams are required, use draftsmen capable of preparing Drawings clearly in an understandable format.
- B. Instructions for the **COUNTY'S** Personnel: For instruction of operating and maintenance personnel, use experienced instructors thoroughly trained and experienced in the operation and maintenance of the building equipment or system involved.

1.4 SUBMITTALS

- A. Submit three (3) copies of each required records, maintenance, operating, warranty manuals after issuance of the Certificate of Substantial Completion, but prior to the Final Completion. Manuals

shall be submitted and prepared in compliance with Section 01 30 00 "Construction Manager Submittals," Section 01 70 00 "Project Closeout," and Section 01 72 00 "Project Record Drawings." Additionally submit an electronic copy of these documents.

- B. Submittal Schedule: Comply with the following schedule for submittal of operating and maintenance manuals.
1. Before Substantial Completion, when each installation that requires submittal of operating and maintenance manuals is nominally complete, submit two draft copies of each manual to the Professional for review. Include a complete index or table of contents of each manual.
 - a. The Professional will return one copy of the draft with comments within fifteen calendar days of receipt.
 2. Submit one copy of data in final form at least fifteen calendar days before final inspection. This copy will be returned within fifteen calendar days after final inspection, with comments.
 3. After final inspection make corrections or modifications to comply with the Professional's and Project Manager's comments. Submit the specified number of copies of each approved manual to the Project Manager within fifteen calendar days of receipt of the Professional's and Project Manager's comments.
- C. Form of Submittal: Prepare operating and maintenance manuals in the form of an instructional manual for use by the User's operating personnel. Organize into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder.
1. Binders: For each manual, provide white heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, in thickness necessary to accommodate contents, sized to receive 8-1/2" by 11" paper. Provide a clear plastic sleeve on the cover and spine, to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
 - a. Where two or more binders are necessary to accommodate data, correlate data in each binder into related groupings in accordance with the Project Manual table of contents. Cross-reference other binders where necessary to provide essential information for proper operation or maintenance of the piece of equipment or system.
 - b. Identify each binder on the front and spine, with the typed or printed title "OPERATION AND MAINTENANCE MANUAL", Project title or name, and subject matter covered. Indicate the volume number for multiple volume sets of manuals.
 2. Dividers: Provide heavy paper dividers with celluloid covered tabs for each separate Section. Mark each tab to indicate contents. Provide a typed description of the product and major parts of equipment included in the Section on each divider.
 3. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
 4. Text Material: Where written material is required as part of the manual, use the manufacturer's standard printed material, or if it is not available, specially prepared data, neatly typewritten, on 8-1/2" by 11", 20-pound white bond paper.
 5. Drawings: Where drawings or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind in with the text.

- a. Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a fold-out.
- b. If drawings are too large to be used practically as a fold-out, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a typewritten page indicating the drawing title, description of contents and drawing location at the appropriate location in the manual.

Additionally, all of the above manuals are to be provided in an electronic copy.

1.5 CONTENT OF MANUALS

- A. In each manual include information specified in the individual Specification Section, and the following information for each major component of building equipment and its controls:
 1. General system or equipment description.
 2. Design factors and assumptions.
 3. Copies of applicable Shop Drawings and Product Data.
 4. System or equipment identification, including:
 - a. Name of manufacturer.
 - b. Model number.
 - c. Serial number of each component.
 5. Operating instructions.
 6. Emergency instructions.
 7. Wiring diagrams.
 8. Inspection and test procedures.
 9. Maintenance procedures and schedules.
 10. Precautions against improper use and maintenance.
 11. Copies of warranties.
 12. Repair instructions including spare parts listing.
 13. Sources of required maintenance materials and related services.
 14. Architectural materials and finishes.
 15. Fixture lighting schedule.
 16. Manual Index.
- B. Organize each manual into separate Sections for each piece of related equipment. As a minimum each manual shall contain a title page, a table of contents, copies of Product Data, supplemented by drawings and written text, and copies of each warranty, bond and service Contract issued.
 1. Title Page: Provide a title page in a transparent plastic envelope as the first sheet of each manual. Provide the following information:
 - a. Subject matter covered by the manual.
 - b. Name, address and number of the Project.
 - c. Date of submittal.
 - d. Name, address, and telephone number of the Contractor.
 - e. Name and address of the Professional.
 - f. Cross reference to related systems in other operating and maintenance manuals.

2. Table of Contents: After the Title Page, include a typewritten table of contents for each volume, arranged systematically according to the Project Manual format. Include a list of each product included, identified by product name or other appropriate identifying symbol and indexed to the content of the volume.
 - a. Where more than one volume is required to accommodate data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
3. General Information: Provide a general information Section immediately following the Table of Contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the Subcontractor or installer, and the maintenance contractor. Clearly delineate the extent of responsibility of each of these entities. In addition, list a local source for replacement parts and equipment.
4. Product Data: Where manufacturer's standard printed data is included in the manuals, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one item in a tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information that is not applicable.
5. Written Text: Where manufacturer's standard printed data is not available, and information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement data included in the manual, prepare written text to provide necessary information. Organize the text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure.
6. Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems, or to provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
7. Do not use original Project Record Documents as part of the Operating and Maintenance Manuals.
8. Warranties, Bonds and Service Contracts: Provide a copy of each warranty, bond or service contract in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to be followed in the event of product failure. List circumstances and conditions that would affect validity of the warranty or bond.

1.6 ARCHITECTURAL MATERIAL AND FINISHES MAINTENANCE SECTIONS

- A. Submit each manual, in final form, on material and finishes to the Project Manager for distribution. Provide one section for architectural products, including applied materials and finishes, and a second for products designed for moisture- protection and products exposed to the weather.
 1. Refer to individual Specification Sections for additional requirements on care and maintenance of materials and finishes.
- B. Architectural Products: Provide manufacturer's data and instructions on care and maintenance of architectural products, including applied materials and finishes.

1. Manufacturer's Data: Provide complete information on architectural products, including the following, as applicable:
 - a. Manufacturer's catalog number.
 - b. Size.
 - c. Material composition.
 - d. Color.
 - e. Texture.
 - f. Reordering information for specially manufactured products.
 2. Care and Maintenance Instructions: Provide information on care and maintenance including manufacturer's recommendations for types of cleaning agents to be used and methods of cleaning. Provide information regarding cleaning agents and methods that could prove detrimental to the product. Include manufacturer's recommended schedule for cleaning and maintenance.
- C. Moisture-Protection and Weather-Exposed Products: Provide complete manufacturer's data with instructions on inspection, maintenance and repair of products exposed to the weather or designed for moisture-protection purposes.
1. Manufacturer's Data: Provide manufacturer's data giving detailed information, including the following, as applicable:
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Installation details.
 - d. Inspection procedures.
 - e. Maintenance information.
 - f. Repair procedures.
- D. Schedule: Provide complete information in the materials and finishes manual on products as determined by Project Manager and Professional and User during review of Final Construction Documents.

1.7 EQUIPMENT AND SYSTEMS MAINTENANCE SECTIONS

- A. Submit each completed manual on equipment and systems, in final form, to the Professional for distribution. Provide separate sections for each unit of equipment, each operating system, and each electric and electronic system.
1. Refer to Specification Sections for additional requirements on operating and maintenance of the various pieces of equipment and operating systems.
- B. Equipment and Systems: Provide the following information for each piece of equipment, each building operating system, and each electric or electronic system.
1. Description: Provide a complete description of each unit and related component parts, including the following:
 - a. Equipment or system function.
 - b. Operating characteristics.
 - c. Limiting conditions.

- d. Performance curves.
 - e. Engineering data and tests.
 - f. Complete nomenclature and number of replacement parts.
- 2. Manufacturer's Information: For each manufacturer of a component part or piece of equipment provide the following:
 - a. Printed operating and maintenance instructions.
 - b. Assembly drawings and diagrams required for maintenance.
 - c. List of items recommended to be stocked as spare parts.
- 3. Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following:
 - a. Routine operations.
 - b. Trouble-shooting guide.
 - c. Disassembly, repair and reassembly
 - d. Alignment, adjusting and checking.
- 4. Operating Procedures: Provide information on equipment and system operating procedures, including the following:
 - a. Start-up procedures.
 - b. Equipment or system break-in.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Instructions on stopping.
 - f. Shut-down and emergency instructions.
 - g. Summer and winter operating instructions.
 - h. Required sequences for electric or electronic systems.
 - i. Special operating Instructions.
- 5. Servicing Schedule: Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.
- 6. Controls: Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.
- 7. Coordination Drawings: Provide each Contractor's Coordination Drawings.
 - a. Provide as-installed color-coded piping diagrams, where required for identification.
- 8. Valve Tags: Provide charts of valve tag numbers, with the location and function of each valve.
- 9. Circuit Directories: For electric and electronic systems, provide complete circuit directories of panelboards, including the following:
 - a. Electric service.
 - b. Controls.
 - c. Communication.
- C. Required Maintenance Schedule: Provide complete information in the equipment and systems manual on products to be determined by Project Manager, Professional and User during review of final construction documents. The **CONTRACTOR** shall include a "Required Maintenance

Schedule". The schedule shall list all items requiring specific manufacturer's, vendor's, and supplier's maintenance requirements. The schedule shall include the items, recommended period of maintenance, required and type of maintenance, repairs and/or replacement parts.

1. Required maintenance items shall include all areas of the project, examples: building exterior envelope (walls, windows, roof), site interior finishes, landscaping, mechanical, plumbing, electrical, and lighting systems.

1.8 INSTRUCTIONS OF THE COUNTY USER'S PERSONNEL

A. Prior to final inspection, instruct the **COUNTY'S** personnel in operation, adjustment, and maintenance of products, equipment and systems. Provide instruction at mutually agreed upon times and as indicated in Section 01 70 00 "Project Close-Out"

1. For equipment that requires seasonal operation, provide similar instruction during other seasons.
2. Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 73 00

SECTION 01 73 00 – EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.
- B. Related Sections include the following:
 - 1. Section 01 04 00 "Project Coordination" for procedures for coordinating field engineering with other construction activities.
 - 2. Section 01 05 00 "Field Engineering" for submitting surveys.
 - 3. Section 01 04 50 "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
 - 4. Section 01 70 00 "Construction Completion..." for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.

- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
- C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 8 feet (2.4 m).
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
- G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 COUNTY-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for COUNTY construction forces.
- B. Coordination: Coordinate construction and operations of the Work with work performed by COUNTY construction forces.
 - 1. Construction Schedule: Inform COUNTY of CONTRACTOR'S preferred construction schedule for COUNTY portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify COUNTY if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include COUNTY construction forces at preinstallation conferences covering portions of the Work that are to receive COUNTY work. Attend preinstallation conferences conducted by COUNTY construction forces if portions of the Work depend on COUNTY construction.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.

2. Broom-clean or vacuum the entire work area, daily.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section 01 04 50 "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

SECTION 01 73 20 – INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the **CONTRACT**, including General Terms and Special Conditions and other Division-1 Specification sections apply to this section.

1.2 SUMMARY

- A. Section includes general requirements and procedures for achieving acceptable indoor air quality for the interior areas of this Project during construction, and preventing contamination of ductwork, HVAC equipment, and other building materials to avoid IAQ problems for workers and for occupants in the future after occupancy. Work includes requirements on the use of permanent building mechanical systems prior to Owner's acceptance.
- B. **CONTRACTOR** shall prepare and submit an Indoor Air Quality (IAQ) Management Plan.

1.3 SUBMITTALS

- A. **IAQ Construction Management Plan:** Submit the plan within thirty (30) days of the date established for commencement of the Work. Update and resubmit plan as required during construction process to reflect Project conditions.
- B. **Meeting Minutes:** Submit minutes from the **CONTRACTOR** meetings related to the execution and verification of the IAQ Construction Management Plan.
- C. **Product Data:** Submit cut sheets of filtration media proposed for use.

1.4 QUALITY ASSURANCE

- A. Contractor's Construction IAQ Management Plan shall meet or exceed the 5 recommended design approaches of SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction, latest edition, ANSI/SMACNA, (Chapter 3), and shall embody the principals and practices set forth in this Section.
- B. **IAQ Management Conference:** Conduct conference at Project site to comply with the requirements in Division 1 Section "Project Management and Coordination."
 - 1. Review methods and procedures related to IAQ management during construction.
 - 2. Review IAQ management requirements with each trade.

1.5 IAQ CONSTRUCTION MANAGEMENT PLAN

- A. CONTRACTOR IAQ Construction Management Plan shall include procedures to prevent indoor air quality problems resulting from the construction process in order to help sustain the comfort and well-being of construction workers and future building occupants.
- B. CONTRACTOR'S detailed plan shall be based on the particular characteristics of the Project.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 HVAC PROTECTION (SMACNA Approach number 1)

- A. Store HVAC equipment including but not limited to items such as ducting, registers, air handler components, fans, and motors in a clean, dry location, protected from dust and other contaminants, and covered with plastic until installed
- B. Seal all HVAC inlets and outlets.
- C. Use of the HVAC system shall be avoided during construction, until drywall construction and activities that produce dust or particulate pollution have been completed. Temporary ventilation may be installed to remove contaminants. All HVAC components including but is not limited to outside air inlets, grills, diffusers, supply ducts, return ducts, ceiling plenums, VAV (variable air volume) plenum intakes, and window ventilator or air conditioning units shall be sealed during construction.
- D. Seal HVAC components during installation. Ducts runs that require several days to install, sections shall be sealed off as they are completed. Seals shall be removed prior to continuing the duct run. Other components of the HVAC system shall be subject to the same requirements to protect from contamination.
- E. Provide frequent inspection and maintenance, of HVAC component protection. Replace as necessary. If inspections by the Architect, Engineer, Owner, or Commissioning Agent reveal that the ductwork has been contaminated due to inadequate protection, the ductwork shall be cleaned professionally prior to activation the HVAC system or occupancy, using procedures established in ACR 2005 published by the National Air Duct Cleaners Association. HVAC components have been damaged or contaminated shall be cleaned or replaced as necessary.
- F. Use temporary filtration media. If HCAC system is to be used while construction work is being done, temporary media filtration media shall be installed on all air intakes. Such filtration shall have a minimum filtration efficiency (Minimum Efficiency Reporting Value-MERV per ASHRAE 52.2) of 8. For air intakes into other parts of the building that are very sensitive, such as computer rooms, filtration media with a MERV rating of 13 or higher is required.
- G. Inspect filters weekly replace as needed for proper filtration and air flow.

- H. Avoid contamination of air entry into enclosed parts of the building. When outdoor construction activities generate dust, combustion emissions, or other contaminants, operable windows and outside air supplies to enclosed portions of the building will be closed or sealed.
- I. Do not use fan, mechanical, or electrical rooms to store construction or waste materials. Keep these rooms clean and neat.
- J. Ceiling tiles shall not be installed until after drywall and painting is complete to avoid contamination of ceiling tiles that will form the return air plenum.

3.2 SOURCE CONTROL (SMACNA Approach number 2)

- A. The use of moisture-damaged materials shall not be allowed. Any porous materials that have become wet shall be dried thoroughly within 48 hours and before installation. Any materials damaged, showing visible mold, or that are wet for over 48 hours shall be removed from the site appropriately.
- B. Contractor to ensure that the construction process will not result in moisture intrusion. In the event of rain or groundwater intrusions notify the Owner's representative.
- C. Avoid tracking pollutants into the work areas.
 - 1. At the start of framing and mechanical system installation access to the building shall be controlled to minimize the tracking of contaminants.
 - 2. Material deliveries and construction waste removal shall be routed by the most direct route to and from the building exterior.
 - 3. Provide rough track off grates or matting at the entryway to remove moisture and contaminants from pedestrian traffic.
 - 4. Prevent the ingress of rodents and pests.
 - 5. Food and drinks other than water shall not be allowed in the building.
 - 6. Trash containers will be primarily located outside of the building. Any interior trash containers will be emptied twice a week at a minimum.
 - 7. Use procedures to insure that there is no smoking in the building, storage areas of absorptive materials, or within 25 ft of air intakes or building openings.
- D. Limit construction traffic and monitor idling vehicles and equipment in the vicinity of air intakes when the HVAC systems are activated. Restrict vehicles to a loading area, well removed from air intakes. Prevent emissions from being drawn into the building.
- E. Use electric or natural gas alternatives to for gasoline and diesel equipment when possible.
- F. All personnel lifts used inside the building will be electrically operated to prevent emissions inside the building.
- G. Cycle vehicles and equipment off when not being used.
- H. Avoid the use of materials and products with high VOC and particulate levels. Inside the building use products and installation methods with low VOCs such as paints and coatings,

adhesives and sealants, and cleaners.

- I. Keep containers of wet products closed when not in use. Cover and seal materials which can release odor or dust.
- J. Containers of fuel, volatile liquids, and materials with high VOC content shall be tightly sealed and stored outside of the building.
- K. Protect absorbent materials from moisture during delivery to and storage at the job site. Store materials in a dry and clean environment.

3.3 PATHWAY INTERRUPTION (SMACNA Approach number 3)

- A. Use dust curtains or temporary enclosures to prevent dust from migrating to other areas when applicable. During construction, isolate areas of work to prevent contamination of clean or occupied areas.
- B. Keep pollutant sources as far away as possible from absorptive materials, ductwork, and areas occupied by workers.
- C. Isolate work areas and or create pressure differentials to prevent the migration of contaminants.
- D. Use portable fan systems to exhaust contaminated air directly to the outside of the building, and discharge the air to prevent recirculation.

3.4 HOUSE KEEPING (SMACNA Approach number 4)

- A. Keep HVAV components, not limited to coils, air filters, dampers, fans, and ductwork, clean during installation, and clean them as required prior to performing the testing, adjusting and balancing of the systems.
- B. Construction shall minimize the production and accumulation of dust and other contaminants. Use integral dust collection systems on drywall sanders, cut saws, and routers. Confine dust-generation activities to areas where cleaning can be carried out easily and where contaminants will not be tracked or contaminate other areas.
- C. Wetting agents or sweeping compounds shall be used to keep dust from becoming airborne.
- D. Wet cloths, damp mops, and vacuum cleaners with high efficiency particulate (HEPA) filters shall be used to clean. Cleaning frequency shall be increased when dust accumulation is noted.
- E. All spills and excess applications of solvent-containing products shall be cleaned using approved methods immediately. Water spills shall be cleaned-up promptly.
- F. Avoid accumulation of water inside the building and promptly remove any water that may occur. Protect porous materials such as insulation, ceiling tiles and drywall from water or moisture.

- G. Construction areas shall be kept dry. Promptly repair any leaks or penetrations that allow water to enter the building. Use dehumidification as necessary for prompt drying of wet surfaces and materials.
- H. Clean rough track off grates or matting at the entryway as necessary, at a minimum weekly to reduce dirt and particulates from entering the building, when building is enclosed.
- I. Cleaning Agents: Use Cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable use products that comply with the California Code of Regulations maximum allowable VOC levels.

3.5 SEQUENCING AND SCHEDULING (SMACNA Approach number 5)

- A. Schedule the installation of porous materials after enclosure of the building. Porous materials shall not be installed until the building envelope is fully weather tight.
- B. Install porous or absorbent materials such as ceiling tiles, after odorous activities including drywall installation, painting, and floor finishing is completed.
- C. Do not allow contaminants from an area under construction to enter the HVAC systems or to migrate to completed areas of construction.
- D. Install new MERV 8 filters prior to the FF&E move-in and occupancy.
- E. Install furnishing after interior finishes have applied and fully cured.
- F. Provide adequate ventilation during curing period. To aid in curing of interior finishes and other products used during construction and to remove pollutants after drywall installation is complete provide adequate ventilation with 100% outside air, and proper filtration for any HVAC components activated. During humid periods or when high moisture materials are present, supplementary dehumidification may be required.
- G. All sanding of the concrete floors, floor preparation, and the poured-in-place terrazzo will be scheduled before the HVAC system startup.
- H. All drywall sanding and painting will be scheduled before the HVAC system startup.
- I. Move-in of all FF&E will occur after all construction activities have been substantially completed and the HVAC has been tested and balanced.

3.6 MONITORING AND IMPLEMENTATION OF IAQ PLAN

- A. Contractor to designate an on-site responsible staff member for instructing personnel and overseeing the Construction IAQ Management Plan.

- B. Provide weekly Contractor site co-ordination meetings with subcontractors. Review appropriate components of the IAQ Construction Management Plan as a regular action item. Document the implementation of the Plan in the meeting minutes, and update the IAQ Construction Management Plan as required.
- C. Subcontractors and their employees shall be provided instruction and Training in the Indoor Air Quality (IAQ) Management Plan.
- D. Recording format: Use SMACNA IAQ Guidelines Appendix C (Planning Checklist) and Appendix D (Inspection Checklist) as a guide.

END OF SECTION 01 73 20

SECTION 017400 – WARRANTIES, BONDS, AND SERVICE CONTRACTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General Terms and Special Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties. In addition, it lists those items for which a one year maintenance service contract is required as part of the **CONTRACTOR'S** Base Bid Price.
1. Refer to the General Conditions for terms of the **CONTRACTOR'S** special warranty of workmanship and materials.
 2. General closeout requirements are included in Section "Project Closeout."
 3. Specific requirements for warranties for the WORK and products and installations that are specified to be warranted are included in the individual Sections of Divisions 2 through 16.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the **CONTRACTOR** of the warranty on the WORK that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the **CONTRACTOR**.

1.3 DEFINITIONS

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the **COUNTY**.
- B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the **COUNTY**.

1.4 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting warranted Work that has failed, 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 has failed and been corrected by replacement or rebuilding; reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

- C. Replacement Cost: Upon determination that WORK covered by a warranty has failed, replace or rebuild the WORK to an acceptable condition complying with requirements of Contract Documents. The **CONTRACTOR** is responsible for the cost of replacing or rebuilding defective WORK regardless of whether the **COUNTY** has benefited from use of the WORK through a portion of its anticipated useful service life.
- D. **COUNTY'S** Recourse: Written warranties made to the **COUNTY** are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the **COUNTY** can enforce such other duties, obligations, rights, or remedies.
1. Rejection of Warranties: The **COUNTY** reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- E. The **COUNTY** reserves the right to refuse to accept WORK for the Project where a special warranty, certification, or similar commitment is required on such WORK or part of the WORK, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS

- A. Submit written warranties to the **PROJECT MANAGER** prior to the date certified for Substantial Completion. If the **PROJECT MANAGER'S** Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the WORK, or a designated portion of the WORK, submit written warranties upon request of the **PROJECT MANAGER**.
1. When a designated portion of the WORK is completed and occupied or used by the **COUNTY'S**, by separate agreement with the **COUNTY'S** during the construction period, submit properly executed warranties to the **PROJECT MANAGER** within fifteen days of completion of that designated portion of the WORK.
- B. When a special warranty is required to be executed by the **CONTRACTOR**, or the **CONTRACTOR** and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the **PROJECT MANAGER** for approval prior to final execution.
1. Refer to individual Sections of Divisions-2 through -16 for specific content requirements, and particular requirements for submittal of special warranties.
- C. Form of Submittal: At Final Completion compile three (3) copies of each required warranty and bond properly executed by the **CONTRACTOR**, or by the **CONTRACTOR'S** subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- D. Bind warranties and bonds in white heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by

11" paper. Provide a clear plastic sleeve on the cover and spine, to hold labels describing the contents.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.
2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the Project title or name, and the name of the **CONTRACTOR**.
3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 SCHEDULE OF WARRANTIES

- A. Schedule: Provide the following warranties on products and installations and those required in the Technical Specifications. In the case of conflicts, the longer of the two requested warranty periods will govern.

ITEM		REQUIRED WARRANTY PERIOD
1.	Termite control	5 Years
2.	Landscape	1 Year
3.	Metal Fascia Soffit	
4.	Roof	
	a. Manufacturer	20 Years
	b. Installation	2 Years
5.	Metal Standing Seam Canopy Roof	
	a. Manufacturer	20 Years
	b. Installation	2 Years
	c. Weathertightness	20 Years
6.	Joint Sealants:	
	a. Manufacturer	5 Years
	b. Installation	5 Years
7.	Aluminum Store Front:	
	a. Manufacturer	2 Years
	b. Finish	20 Years
8.	Wood Doors	10 Year
9.	Louvers	20 Years (Finish)
10.	Meters and Gauges	2 Years
11.	Motors	5 Years
12.	Fans	5 Years
13.	Refrigeration Compressors	5 Years
14.	Water Heaters	3 Years tank, (1 Year-parts only)
15.	Temperature Control System	2 years
16.	Air Cooled Condensing Units	1 Year, (5 Years - parts only)

17.	Electric Water Cooler Compressor	5 Years
18.	Pumps	1 Year, (5 Years - parts only)
19.	Transfer Switches	1 Year (labor only)
20.	Air Handling Units	1 Year, (5 Years - parts only)
21.	Fire Alarm System	1 Year
22.	Fire Sprinkler System	2 Years

3.2 MAINTENANCE SERVICE AGREEMENT OPTION

- A. In addition to warranties, bonds and extended warranties, the County, at its option, may select to have the **COTRACTOR** provide a Maintenance and Service Agreement which may include, but may not be limited to, the following items listed below:
1. Roofing Maintenance
 2. HVAC System Maintenance
 3. Fire Pump Maintenance
 4. Smoke and Fire Alarms Maintenance
- B. The Service Agreement shall be provided in accordance with the Contract Documents. The Service Agreement shall be for one year and renewable every year, for a period of up to five years.

END OF SECTION 017400

SECTION 01 74 20 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Special Conditions, and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 10 days of date established for Notice to Proceed.

1.5 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: The Waste Management coordination shall be a full-time member of the Contractor's onsite field team. The Waste Management Coordinator may have other on-site project responsibilities.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Burning: Burning of waste materials is permitted only at designated areas on COUNTY property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.
- D. Disposal: Remove waste materials from COUNTY property and legally dispose of them.

END OF SECTION 01 74 20

SECTION 01 79 00 – DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the **CONTRACT**, including General Terms and Special Conditions and other Division-1 Specification sections apply to this section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing COUNTY personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training presentation.

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, experienced in operation and maintenance procedures and training.
- B. Pre-Instruction Conference: Conduct conference at Project site to comply with review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.

1.5 COORDINATION

- A. Coordinate instruction schedule with COUNTY operations. Adjust schedule as required to minimize disrupting COUNTY operations and to ensure availability of COUNTY personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training presentation with content of approved emergency, operation, and

maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by PROFESSIONAL.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes a training presentation for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Presentation: Develop a learning objective and teaching outline for each presentation. Include a description of specific skills and knowledge that participant is expected to master. For each presentation, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Operating standards.
 - c. Regulatory requirements.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Identification systems.
 - e. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Shutdown instructions for each type of emergency.
 - c. Operating instructions for conditions outside of normal operating limits.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Normal shutdown instructions.
 - h. Operating procedures for system, subsystem, or equipment failure.
 - i. Seasonal and weekend operating instructions.
 - j. Required sequences for electric or electronic systems.
 - 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
 - 6. Troubleshooting: Include the following:

- a. Diagnostic instructions.
- b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for routine and preventative maintenance.
 - f. Instruction on use of special tools.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training material and assemble into a training manual.
- B. Set up instructional equipment at instruction location.
- C. Provide a list of attendees.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct COUNTY personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. COUNTY will furnish CONTRACTOR with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. Schedule training with COUNTY, through PROFESSIONAL, with at least seven (7) days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Cleanup: Collect used and leftover educational materials and give to COUNTY. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01 79 00

SECTION 01 2900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.
- B. Format and Content:
 - 1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Use the SDHC standard Schedule of Values format.
 - a. Refer to Sample Schedule of Values, based on AIA document G703 (Appendix 6).
 - 3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value.
 - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 - 5. The Owner only makes payment for work in place, not stored materials
 - 6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 - 7. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

- B. Payment Application Forms: Use forms provided by The American Institute of Architects for Applications for Payment.
- C. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 - 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- D. Transmittal: Submit 2 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
 - 2. Electronic Copy: provide a .pdf version of the full pay application. Bookmark each section.
 - 3. Provide an updated project schedule with each pay application.
- E. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. Schedule of Values.
 - 2. Contractor's Construction Schedule (preliminary if not final).
 - 3. Submittals Schedule (preliminary if not final).
- F. Application for Payment at Substantial Completion: After issuance of the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
- G. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Closeout Documents as identified in the HCPS Close-Out Checklist (Appendix 5).
 - 2. Final Change Order to include:
 - a. Recovery of unspent Owner's Contingency
 - b. Recovery of unspent CM Contingency
 - c. Recovery of unspent Reimbursable amounts, buyout, allowances and any other unspent GMP funds.
 - d. Recovery of unspent general conditions (amount to be previously approved by the Coordinator)
 - 1) Required back up for items b, c, and d consists of the Schedule of Values from with the last PAID pay application, with the unspent amounts circled. Note: unspent amounts cannot be approved by Change Order until all expenditures have been approved. Therefore, a semi-final pay application which releases all monies due, except for the remaining CM fee and unspent amounts, must be submitted prior to submitting the final Change Order.
 - e. Time extensions, including those that have been previously approved via OCA or CCD
 - f. Liquidated damages and reimbursement for work performed by the owner, if applicable
 - 3. A "semi-final" pay application to release all monies due, except for the remaining CM fee and unspent amounts, must be submitted prior to submitting the final Change Order.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General project coordination procedures.
 - 2. Coordination Drawings.
 - 3. Administrative and supervisory personnel.
 - 4. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 2. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's Construction Schedule.
 - 2. Preparation of the Schedule of Values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.

1.4 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
 - 1. Indicate relationship of components shown on separate Shop Drawings.
 - 2. Indicate required installation sequences.
 - 3. Refer to Division 15 Section "Mechanical Requirements" and Division 16 Section "Basic Methods and Requirements" for specific Coordination Drawing requirements for mechanical and electrical installations.
- B. Staff Names: Within 15 days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list telephone numbers including email addresses and cell phone numbers.

1.5 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.
- B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Construction Manager, installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Owner, of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related Change Orders.
 - d. Deliveries.
 - e. Submittals.
 - f. Review of mockups.
 - g. Possible conflicts.
 - h. Compatibility problems.
 - i. Time schedules.
 - j. Weather limitations.
 - k. Manufacturer's written recommendations.
 - l. Warranty requirements.
 - m. Compatibility of materials.
 - n. Acceptability of substrates.
 - o. Temporary facilities and controls.
 - p. Space and access limitations.
 - q. Regulations of authorities having jurisdiction.
 - r. Testing and inspecting requirements.
 - s. Required performance results.
 - t. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements.
4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Preliminary Construction Schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Submittals Schedule.
 - 4. Preliminary Network Diagrams.
 - 5. CPM reports.
 - 6. Field condition reports.
 - 7. Special reports.
- B. Related Sections include the following:
 - 1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
 - 2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
 - 3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
 - 4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
 - 2. Predecessor activity is an activity that must be completed before a given activity can be started.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- G. Major Area: A story of construction, a separate building, or a similar significant construction element.
- H. Milestone: A key or critical point in time for reference or measurement.
- I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.4 SUBMITTALS

- A. Submittals Schedule: Submit schedule in .pdf format. Arrange the following information in a tabular format:
 - 1. Scheduled date for first submittal.
 - 2. Specification Section number and title.
 - 3. Submittal category (action or informational).
 - 4. Name of subcontractor.
 - 5. Description of the Work covered.
 - 6. Scheduled date for Architect's final release or approval.
- B. Preliminary Construction Schedule: Submit in .pdf format.
- C. Preliminary Network Diagram: Submit two printed copies; large enough to show entire network for entire construction period.

- D. Contractor's Construction Schedule: Submit two printed copies of initial schedule, large enough to show entire schedule for entire construction period.
 - E. CPM Reports: Concurrent with CPM schedule, submit two printed copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.
 - F. Field Condition Reports: Submit two copies at time of discovery of differing conditions.
 - G. Special Reports: Submit two copies at time of unusual event.
- 1.5 COORDINATION
- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
 - B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from parties involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
 - 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 - 2. Initial Submittal: Submit concurrently with preliminary network diagram. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - a. At Contractor's option, show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from construction commencement date to date of Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 21 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 - 4. Startup and Testing Time: Include not less than 14 days for startup and testing.
 - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Seasonal variations.

- c. Environmental control.
 - 3. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Fabrication.
 - d. Installation.
 - e. Tests and inspections.
 - f. Startup and placement into final use and operation.
 - E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
 - F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.
- 2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)
- A. General: Prepare network diagrams using AON (activity-on-node) format.
 - B. Preliminary Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
 - C. CPM Schedule: Prepare Contractor's Construction Schedule using a CPM network analysis diagram.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
 - 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 3. Use "one workday" as the unit of time.
 - D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Purchase of materials.
 - c. Delivery.
 - d. Fabrication.
 - e. Installation.
 - 2. Processing: Process data to produce output data or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 - 3. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
 - E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Principal events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.
 - 6. Early and late finish dates.
 - 7. Activity duration in workdays.
 - 8. Total float or slack time.
 - F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Updated Schedules shall be submitted with each Pay Application.
 - 2. Identification of activities that have changed.
 - 3. Changes in early and late start dates.
 - 4. Changes in early and late finish dates.
 - 5. Changes in activity durations in workdays.
 - 6. Changes in the critical path.
 - 7. Changes in total float or slack time.
 - 8. Changes in the Contract Time.

2.4 REPORTS

- A. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 AERIAL PHOTOGRAPHY

- A. Provide aerial photography for the project during the project's Construction Schedule.
 - 1. Aerial Photographs will accompany each monthly Pay Application.
 - 2. Aerial Photos are to display the name of the Facility, the date the photo was shot, and the name of the aerial photography company. No other labeling is to be provided.
 - 3. Aerial Photographs will also be distributed to the Design Team and Owner in an electronic format.
 - 4. Quantity: provide a minimum of three photos per month. One shall show the overall site.

2.6 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, Approved Products List, and other miscellaneous submittals.
- B. Related Sections include the following:
 - 1. Division 1 Section "Payment Procedures" for submitting Applications for Payment.
 - 2. Division 1 Section "Project Management and Coordination" for submitting Coordination Drawings.
 - 3. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
 - 4. Division 1 Section "Quality Requirements" for submitting test and inspection reports and Delegated-Design Submittals and for erecting mockups.
 - 5. Division 1 Section "Quality Requirements" for submitting test and inspection reports and Delegated-Design Submittals.
 - 6. Division 1 Section "Closeout Procedures" for submitting warranties, Project Record Documents and operation and maintenance manuals.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's approval. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

- A. General: Submit submittals in Adobe Portable Document Format (PDF) minimum version 8.0 with Submittal Transmittal in Word for Windows minimum version 2000 (Word) to Architect for review.
- 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. 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 Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 - b. Submit color selection data as a single package. Color selections will be made at the same time. Architect will return color selections on a schedule a copy of which is included at the end of this section.
 - 3. Dissimilar Metals: The Construction Manager shall coordinate and verify that independent building systems are installed in such a manner to avoid the direct contact of dissimilar metals to prevent the occurrence of galvanic corrosion.
- C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.
 - 1. Initial Review: Allow 15 calendar days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Construction Manager when a submittal being processed must be delayed for coordination.
 - 2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow 15 calendar days for initial review of each submittal.
 - a. Structural Steel
 - b. Miscellaneous Metals
 - c. Division 14
 - d. Division 15
 - e. Division 16
 - 3. If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 4. Allow 15 calendar days for processing each resubmittal.
 - 5. Allow 30 calendar days for processing color selection. The review period commences on the date that the last color sample is submitted. Where samples are required, printed materials will not be accepted.

6. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- E. Identification: Place a permanent label or title block on each submittal for identification. Provide in PDF for electronic submittals.
 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space beside title block to record Contractor's review and approval markings and action taken by Architect and Construction Manager.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Construction Manager.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Number and title of appropriate Specification Section.
 - i. Drawing number and detail references, as appropriate.
 - j. Other necessary identification.
 4. Electronic PDF submittal files shall be named utilizing the specification number followed by a sequential number for the submittal made under the given specification number followed by "r#" if it is a resubmittal, and then followed by a brief description of the submitted item.
 - a. The description shall indicate the actual item submitted, shall not be general in nature, and does not have to be that of the specification section heading.
 - b. Using the example, "15135-4r2 Differential Pressure Gauge"; 15135 – Meters and Gauges is the relevant specification, the "4" shows it was the fourth submittal for specification section 15135, "r2" shows it was the second resubmittal, and the description indicates what item is submitted.
 - c. Each specification item shall be submitted in a separate PDF file. PDF files with multiple specification items will be returned without review.
 - d. Each file shall have sufficient space allowance for the Architects review stamp(s).
 - e. Each file shall have the Constructors Managers review stamp(s) and indicate information required by specification 01 3300-1.4.E.3 above.
 5. All marks made by the Construction Manager shall be in green.
- F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.
- G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect or Construction Manager observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Construction Manager.
 1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.
 2. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.
 3. Transmittal Form: Use sample form at End of Section.
- I. Approved Products List: Submit list of approved products indicating State of Florida Approval Number and expiration date. See sample at end of section.
- J. Submittal Checklist: Provide submittal items as indicated per specification section in the submittal checklist (Appendix 3).

SECTION 01 3400 - INSPECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for coordinating with Owner's personnel, including the following:
 - 1. Required Code Inspections.
 - a. Threshold Inspections.
 - 2. Quality Control Inspections.
 - 3. Substantial Completion Inspection.
 - 4. Final Completion Inspection.
 - 5. One-year Warranty Inspection.

1.3 INSPECTIONS

- A. Florida Building Code Required Inspections:
 - 1. Instructions can be found on the Florida Building Code website, www.floridabuilding.org, regarding inspections that are specifically required by the Florida Building Code, Chapter 1.
 - 2. Threshold Building Inspections:
 - a. Threshold Building Inspections are in the scope of work of the CM. The inspections shall be competitively Bid and awarded by the CM. A copy of the Inspection Report shall be provided to the School District Inspector. The CM shall be responsible for coordinating threshold inspections and obtaining the required Statement of Compliance(s) prior to issuance of a Certificate of Occupancy.
 - 3. Refer to Permit for instructions for requesting code inspections. Code-required inspections are listed on the inspection form issued with the Permit.
 - a. Code Compliance Inspection Request Form will be issued by AHJ with the Permit.
- B. Quality Control Inspections:
 - 1. Requests for inspections which are not specifically required by the Florida Building Code are to be forwarded directly via e-mail to the Architect of Record.
- C. Substantial Completion and Final Completion Inspections:
 - 1. These inspections will be scheduled by Architect upon confirming that the project is ready for inspection. The Project Coordinator is to be alerted seven days in advance of the inspection in order to give School District staff adequate notice. The Architect, Consulting Engineers, and Construction Manager must all be present on the date/time selected for the inspection.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
 - 1. Division 1 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
 - 2. Divisions 2 through 16 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect or Construction Manager.
- C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.
- D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.5 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.
 - 4. Identification of test and inspection methods.
 - 5. Number of tests and inspections required.
 - 6. Time schedule or time span for tests and inspections.
 - 7. Entity responsible for performing tests and inspections.
 - 8. Requirements for obtaining samples.

9. Unique characteristics of each quality-control service.
- D. Reports: Prepare and submit certified written reports that include the following:
 1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Ambient conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Florida and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. School District Standards: Contractor to be familiar with and in adherence with Hillsborough County Public Schools standards for construction.
- G. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.
- H. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

1.7 QUALITY CONTROL

- A. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.
 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. Special Tests and Inspections: Owner may engage a testing agency to conduct special tests and inspections required by Owner.

1. Testing agency will notify Architect and Construction Manager promptly of irregularities and deficiencies observed in the Work during performance of its services.
 2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Architect through Construction Manager and to authorities having jurisdiction.
 3. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Testing agency will retest and reinspect corrected work.
 6. The CM is required to copy the Owner's Building Envelope Consultant and Commissioning Engineer on all requests for quality control and contract compliance inspections.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
 5. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field-curing of test samples.
 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.
 2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Installer": Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- J. "Experienced": When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- K. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: **Comply with standards in effect per the FBC as of date of the Contract Documents, unless otherwise indicated. Refer to the Florida Building Code - BUILDING, Eighth Edition (2023), Chapter 35 - Referenced Standards for the proper date/edition of the referenced standard.** The standards are listed in Chapter 35 by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. If the referenced standard is not governed by the Code, the most recent version of the standard shall apply.
- C. Conflicting Requirements: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source and make them available on request.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The)	(202) 862-5100	www.aluminum.org
AAADM	American Association of Automatic Door Manufacturers	(216) 241-7333	www.aaadm.com
AABC	Associated Air Balance Council	(202) 737-0202	www.aabchq.com
AAMA	American Architectural Manufacturers Association	(847) 303-5664	www.aamanet.org
ACI	American Concrete Institute/ACI International	(248) 848-3700	www.aci-int.org
ACPA	American Concrete Pipe Association	(972) 506-7216	www.concrete-pipe.org
ADC	Air Diffusion Council	(312) 201-0101	www.flexibleduct.org
AGC	Associated General Contractors of America (The)	(703) 548-3118	www.agc.org
AI	Asphalt Institute	(859) 288-4960	www.asphaltinstitute.org
AIA	American Institute of Architects (The)	(202) 626-7300	www.aia.org
AISC	American Institute of Steel Construction	(800) 644-2400	www.aisc.org
AISI	American Iron and Steel Institute	(202) 452-7100	www.steel.org
ANSI	American National Standards Institute	(202) 293-8020	www.ansi.org
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers	(800) 527-4723	www.ashrae.org

ASTM	American Society for Testing and Materials	(610) 832-9585	www.astm.org
AWI	Architectural Woodwork Institute	(800) 449-8811	www.awinet.org
AWPA	American Wood-Preservers' Association	(817) 326-6300	www.awpa.com
AWS	American Welding Society	(800) 443-9353	www.aws.org
AWWA	American Water Works Association	(800) 926-7337	www.awwa.org
BHMA	Builders Hardware Manufacturers Association	(212) 297-2122	<a href="http://www.buildershardw
are.com">www.buildershardw are.com
BIA	Brick Industry Association (The)	(703) 620-0010	www.bia.org
CISPI	Cast Iron Soil Pipe Institute	(423) 892-0137	www.cispi.org
CLFMI	Chain Link Fence Manufacturers Institute	(301) 596-2583	<a href="http://www.chainlinkinfo.o
rg">www.chainlinkinfo.o rg
CRSI	Concrete Reinforcing Steel Institute	(847) 517-1200	www.crsi.org
CSI	Construction Specifications Institute (The)	(800) 689-2900	www.csinet.org
DHI	Door and Hardware Institute	(703) 222-2010	www.dhi.org
FGMA	Flat Glass Marketing Association	(See GANA)	
GA	Gypsum Association	(202) 289-5440	www.gypsum.org
GANA	Glass Association of North America	(785) 271-0208	<a href="http://www.glasswebsite.c
om/gana">www.glasswebsite.c om/gana
ML/SFA	Metal Lath/Steel Framing Association	(See SSMA)	
NAAMM	National Association of Architectural Metal Manufacturers	(312) 332-0405	www.naamm.org

NEBB	National Environmental Balancing Bureau	(301) 977-3698	www.nebb.org
NECA	National Electrical Contractors Association	(301) 657-3110	www.necanet.org
NEMA	National Electrical Manufacturers Association	(703) 841-3200	www.nema.org
NFPA	National Fire Protection Association	(800) 344-3555	www.nfpa.org
NHLA	National Hardwood Lumber Association	(800) 933-0318	www.natlhardwood.org
NRCA	National Roofing Contractors Association	(800) 323-9545	www.nrca.net
RFCI	Resilient Floor Covering Institute	(Contact by mail only)	
SDI	Steel Deck Institute	(847) 462-1930	www.sdi.org
SDI	Steel Door Institute	(440) 899-0010	www.steeldoor.org
SGCC	Safety Glazing Certification Council	(315) 646-2234	www.sgcc.org
SJI	Steel Joist Institute	(843) 626-1995	www.steeljoist.org
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association	(703) 803-2980	www.smacna.org
TCA	Tile Council of America, Inc.	(864) 646-8453	www.tileusa.com
WCMA	Window Covering Manufacturers Association (Formerly: AWCMA - American Window Covering Manufacturers Association)	(800) 506-4653	www.windowcoverings.org
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)	(800) 223-2301	www.wdma.com

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.
1. FBC: Florida Building Code
 - a. www.floridabuilding.org
 - b. (850) 487-1824
 2. ADAAG: Americans with Disabilities Act (ADA)
 - a. Accessibility Guidelines for Buildings and Facilities Available from Access Board
 - b. www.access-board.gov
 3. NFPA: National Fire Protection Association
 - a. www.nfpa.org
 4. FFPC: Florida Fire Prevention Code
 - a. <http://www.myfloridacfo.com/division/sfm/BFP/FloridaFirePreventionCodePage.htm>
 5. NEC: NFPA 70 - National Electrical Code
 - a. <http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=70>

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.
- B. Temporary utilities include, but are not limited to, the following:
 - 1. Sewers and drainage.
 - 2. Water service and distribution.
 - 3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
 - 4. Heating and cooling facilities.
 - 5. Ventilation.
 - 6. Electric power service.
 - 7. Lighting.
 - 8. Telephone service.
- C. Support facilities include, but are not limited to, the following:
 - 1. Dewatering facilities and drains.
 - 2. Project identification and temporary signs.
 - 3. Waste disposal facilities.
 - 4. Field office.
 - 5. Storage and fabrication sheds.
 - 6. Temporary stairs.
 - 7. Construction aids and miscellaneous services and facilities.
 - 8. Utility hookup to temporary classrooms.
- D. Security and protection facilities include, but are not limited to, the following:
 - 1. Environmental protection.
 - 2. Stormwater control.
 - 3. Tree and plant protection.
 - 4. Pest control.
 - 5. Site enclosure fence.
 - 6. Security enclosure and lockup.
 - 7. Barricades, warning signs, and lights.
 - 8. Temporary enclosures.
 - 9. Fire protection.
 - 10. Maintaining Life Safety and Means of Egress.
- E. Related Sections include the following:
 - 1. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 2. Division 1 Section "Execution Requirements" for progress cleaning requirements.
 - 3. Divisions 2 through 16 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 USE CHARGES

- A. General: Connections for temporary facilities that are required where use of existing Facility utilities is not available or possible, are not chargeable to Owner or Architect and shall be included in the Contract Sum. The Contractor is to coordinate directly with the utility provider and make arrangement for payments, and the cost must be included in the GMP. The cost of the connections is to be included in the bid scopes for the respective subcontractors. The cost of running temporary utilities must be competitively bid. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
 - 1. Owner's construction forces.
 - 2. Architect.
 - 3. Testing agencies.
 - 4. Personnel of authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 - 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.

2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
 - B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- 1.5 PROJECT CONDITIONS
- A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
 1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
 - B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
 1. Keep temporary services and facilities clean and neat.
 2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
 - B. Chain-Link Fencing: Minimum 2-inch, 0.148-inch thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts.
 - C. Water: Potable.
- 2.2 EQUIPMENT
- A. General: Provide equipment suitable for use intended.
 1. Field Offices: Prefabricated or Mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.
 - B. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
 - C. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
 - D. Drinking-Water Fixtures: Drinking-water fountains, or containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.
 - E. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
 - F. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.
 - G. Job Sign: provide a job sign at the project entry. Sign example is included in the Appendices.

PART 3 - EXECUTION

- 3.1 INSTALLATION, GENERAL
- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
 - B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- 3.2 TEMPORARY UTILITY INSTALLATION
- A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
 - B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
 1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 2. Toilets: Use of facility in Job Trailer.

3. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
 4. Drinking-Water Facilities: Provide bottled-water, drinking-water units.
 - a. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F.
 - C. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.
 1. Maintain a minimum temperature of 50 deg F in permanently enclosed portions of building for normal construction activities, and 65 deg F for finishing activities and areas where finished Work has been installed.
 - D. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - E. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.
 - F. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
 1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
 - G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - H. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station.
 1. Provide additional telephone lines for the following:
- 3.3 SUPPORT FACILITIES INSTALLATION
- A. General: Comply with the following:
 1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
 - B. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.
 - C. Dewatering Facilities and Drains: Comply with requirements in applicable Division 2 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. Maintain Project site, excavations, and construction free of water.
 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property nor endanger permanent Work or temporary facilities.
 2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.
 - D. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.
 1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.
 2. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thicknesses indicated. Support on posts or framing of preservative-treated wood or steel.
 3. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
 4. Sign template is provide in the Appendices.
 - E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.

1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.
- F. Common-Use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 8 persons at Project site. Keep office clean and orderly.
 1. Furnish and equip offices as follows:
 - a. Desk and four chairs, four-drawer file cabinet, a plan table, a plan rack, and bookcase.
 - b. Water cooler and private toilet complete with water closet, lavatory, and medicine cabinet with mirror.
 - c. Coffee machine and supplies, including regular and decaffeinated coffee, filters, cups, stirring sticks, creamer, sugar, and sugar substitute.
 - d. Provide a room of not less than 240 sq. ft. for Project meetings. Furnish room with conference table, 12 folding chairs, and 4-foot square tack board.
 2. Provide fluorescent light fixtures capable of maintaining average illumination of 20 fc at desk height. Provide 110- to 120-V duplex outlets spaced at not more than 12-foot intervals, 1 per wall in each room.
- G. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.
- B. Stormwater Control: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.
- C. Tree and Plant Protection: Install temporary fencing located outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.
- D. Site Enclosure Fence: Before construction operations begin install chain-link enclosure fence with lockable entrance gates. Locate where indicated, or enclose entire Project site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.
 1. Set fence posts in compacted mixture of gravel and earth or in concrete bases.
 2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
 3. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.
- E. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.
- F. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
 - a. Field Offices: Class A stored-pressure water-type extinguishers.
 - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
 - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
 2. Store combustible materials in containers in fire-safe locations.
 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
 4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
 5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
 6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

7. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns.
 2. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. Prior to requesting the Substantial Completion Inspection, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

END OF SECTION

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Division 1 Section "References" for applicable industry standards for products specified.
 - 2. Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.
 - 3. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- F. FSC Certified Wood: Sustainably harvested wood products meeting the requirements of the Forest Stewardship Council which sets standards for environmentally responsible and socially beneficial forestry.

1.4 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
 - 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 - 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
 - 3. Initial Submittal: Within 45 days after date of commencement of the Work, submit 5 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.

4. Completed List: Within 60 days after date of commencement of the Work, submit 5 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 5. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.
 - B. Products with Recycled Content:
 1. Overall Project Requirement: Provide products with recycled content such that the sum of post-consumer recycled content plus one-half of the post-industrial recycled content constitutes at least 10 percent of the total value of all products installed, except mechanical and electrical components.
 2. Calculations: Where information about recycled content is required to be submitted:
 - a. Determine percentage of post-consumer and post-industrial content separately, using the guidelines contained in 16 CFR 260.7(e).
 - b. Previously used, reused, refurbished, and salvaged products are not considered recycled.
 - c. Determine percentage of recycled content of any item by dividing the weight of recycled content in the item by the total weight of all material in the item.
 - d. Determine value of recycled content of each item separately, by multiplying the content percentage by the value of the item.
 - C. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 15 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Acceptance: Change Order.
 - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
 - D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.
- 1.5 QUALITY ASSURANCE
- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 5. Store products to allow for inspection and measurement of quantity or counting of units.
 6. Store materials in a manner that will not endanger Project structure.
 7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 9. Protect stored products from damage.
 - B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.
- 1.7 PRODUCT WARRANTIES
- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
 3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
 - C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- B. Product Selection Procedures: Procedures for product selection include the following:
 1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
 - a. Substitutions may be considered, unless otherwise indicated.
 2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.

3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Substitutions may be considered, unless otherwise indicated.

2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within 30 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.
- B. Substitutions after bid will be considered only where the specified product has been discontinued. The Owner's specific approval of substituted products is required. Approval by any other means is invalid, including: submittal reviews, RFI responses, and ASIs.

2.3 COMPARABLE PRODUCTS

- A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 7000 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
 - 7. Correction of the Work.
- B. Related Sections include the following:
 - 1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
 - 2. Division 1 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 4. Examine walls, floors, slabs, existing structural elements, and adjacent finishes where products and systems are to be installed.
 - 5. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 6. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- C. Final Property Survey: Prepare a final property survey showing significant features (real property), pavement, drainage structures and contours for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 - 2. Recording: At Substantial Completion, submit survey to the SWFWMD to show compliance with storm water run off requirements.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
- G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
 - 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 01 7310 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Division 7 Section "Through-Penetration Firestop Systems" for patching fire-rated construction.
 - 2. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - 3. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 15 and 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
 - 7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
 - 1. Foundation construction.
 - 2. Bearing and retaining walls.
 - 3. Structural concrete.
 - 4. Structural steel.
 - 5. Lintels.
 - 6. Structural decking.
 - 7. Miscellaneous structural metals.
 - 8. Equipment supports.
 - 9. Piping, ductwork, vessels, and equipment.
- B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 1. Primary operational systems and equipment.
 - 2. Air or smoke barriers.
 - 3. Fire-protection systems.
 - 4. Control systems.
 - 5. Communication systems.
 - 6. Conveying systems.
 - 7. Electrical wiring systems.

- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 1. Water, moisture, or vapor barriers.
 - 2. Membranes and flashings.
 - 3. Equipment supports.
 - 4. Piping, ductwork, vessels, and equipment.
 - 5. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
 - 1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
 - a. Roofing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed 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.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION

SECTION 01 7320 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 1 Section "Summary" for use of the premises and phasing requirements.
 - 2. Division 1 Section "Work Restrictions" for restrictions on use of the premises due to Owner or tenant occupancy.
 - 3. Division 1 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
 - 4. Division 1 Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
 - 5. Division 2 Section "Site Clearing" for site clearing and removal of above and below grade improvements.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of a building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Repair procedures for selective demolition operations.

1.3 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.

1.4 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.

1.5 SUBMITTALS

- A. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing 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.
- B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- C. Predemolition Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.6 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. Professional Engineer Qualifications: Comply with Division 1 Section "Quality Requirements."
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
- F. Inspections: Design Team, Contractor, and Owner shall inspect areas slated for demolition prior to commencement of demolition (after utilities are disconnected) and after demolition is complete.

1.7 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Owner's operations will not be disrupted.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
 2. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - a. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - C. Hazardous Materials: An Asbestos Report has been provided and is included in the Specifications (Appendix 8). The Owner shall handle the abatement of hazardous materials encountered during construction.
 1. Worker's are to have OSHA II Asbestos General Training. Onsite Personnel will be required to have completed the EPA Asbestos Contractor / Supervisor Course.
 2. Storage or sale of removed items or materials on-site will not be permitted.
 3. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - a. Maintain fire-protection facilities in service during selective demolition operations.
- 1.8 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 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.
 3. 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. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. 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.
- E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.
 2. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - a. Arrange to shut off indicated utilities with utility companies.
 - b. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 - c. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

- A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. 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. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.
 - a. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
6. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
 1. Do not use water mist.
 2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.
 3. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - a. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 4. Cleaning: 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.

3.5 SELECTIVE DEMOLITION

- 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 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. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly.
 10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
 11. Existing Facilities: Comply with Owner's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
 12. Removed and Salvaged Items. Comply with the following:
 - a. Clean salvaged items.
 - b. Store items in a secure area until delivery to Owner.

- c. Protect items from damage during transport and storage.
 - 13. Removed and Reinstalled Items: Comply with the following:
 - a. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 - b. Protect items from damage during transport and storage.
 - c. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
 - 14. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.
 - 15. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
 - 16. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
 - 17. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
 - 18. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
 - a. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
 - 19. Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 7 Section for new roofing requirements.
- 3.6 PATCHING AND REPAIRS
 - A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
 - B. Patching: Comply with Division 1 Section "Cutting and Patching."
- 3.7 DISPOSAL OF DEMOLISHED MATERIALS
 - A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
 - 1. Burning: Do not burn demolished materials.
 - 2. Disposal: Transport demolished materials off Owner's property and legally dispose of them.
- 3.8 SCHEDULE OF SALVAGED ITEMS
 - A. The Architect intends to require the salvage and reuse of the following items:
 - 1. None.
 - B. The Owner intends to require the salvage and reuse of the following items:
 - 1. None.

END OF SECTION

SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
 - 2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
 - 3. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for products of those Sections.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project Record Documents.
 - 3. Operation and maintenance manuals.
 - 4. Warranties.
 - 5. Instruction of Owner's personnel.
 - 6. Final cleaning.

1.3 SUBMITTALS

- A. Provide completed version of the following SDHC documents:
 - 1. Owner Training Log.
 - 2. Close-Out Checklist.
 - 3. Door Key Transmittal Form.
- B. Documents are provided in the Appendices.

1.4 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Prepare and submit Field Marked As-built drawings within three weeks after Substantial Completion.
 - 3. Submit as-built Survey within three weeks after Substantial Completion.
 - 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 - 5. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 6. Complete startup testing of systems.
 - 7. Submit test/adjust/balance records within three weeks after Substantial Completion.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements, including touchup painting.
 - 10. Complete final cleaning requirements:
 - a. Elevator hoistways and all equipment therein shall be cleaned and left free of rust, filings, welding slag, rubbish, loose plaster, mortar drippings, extraneous construction materials, dirt and dust. Include walls, building beams, sill ledges, and hoistway divider beams.
 - b. Care shall be taken by workpersons not to mark, soil, or otherwise deface existing or new surfaces. Clean and restore such surfaces to their original condition.
 - c. Clean down surfaces and areas which require final painting and finishing work. Cleaning includes removal of rubbish, broom cleaning of floors, removal of any loose plaster or mortar, dust and other extraneous materials from finish surfaces, and surfaces that will remain visible after the work is complete.
 - d. Final floor waxing shall be completed prior to Substantial Completion.
 - 11. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
 - 12. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

- a. Multiple Inspections: The Architect's Agreement with the Owner includes one Substantial Completion Inspection for the entire project.
 - 1) If the Contractor wants additional Inspections, they will be conducted at the Contractor's expense. Cost of multiple Substantial Completion Inspections will be billed at the Architect's and Engineers' hourly rates as identified in the Architect Owner Agreement.
 - 2) Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - (a) The Architect's Agreement with the Owner includes one reinspection to determine if the Substantial Completion Punch List has been completed. Cost of more than one reinspection will be at the Contractor's expense and will be billed at the Architect's and Engineers' hourly rates as identified in the Architect Owner Agreement.
 - 3) Results of completed inspection will form the basis of requirements for Final Completion.

1.5 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
 1. Submit copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed by Construction Manager. The copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 3. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 4. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - a. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 1) The Architect's Agreement with the Owner includes one inspection to determine Final Completion. Cost of more than one inspection will be at the Contractor's expense and will be billed at the Architect's and Engineers' hourly rates.
 5. Close-Out Documents: submittal of Close-out Documents is a requirement to achieve Final Completion.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit an electronic copy of the list to Architect. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect and Construction Manager.
 - d. Page number.

1.7 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.
- B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
 1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

- d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
 - 1) Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 - 2) Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 3) Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 - 4) Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
- e. At the completion of construction, finalize the Record Drawings. Provide Architect an electronic scanned version of the complete Contract Documents (including all Addenda, Change Orders, CCDs, and Owner Contingency Adjustment Authorizations). Scans of the set must be in color, bookmarked pdfs, with a minimum resolution of 200 dpi.
2. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - a. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - b. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - c. Note related Change Orders, Record Drawings, and Product Data, where applicable.
 - d. At the completion of construction, finalize the Record Specifications. Provide Architect an electronic scanned version of the complete Project Specifications (including all Addenda, Change Orders, CCDs, and Owner Contingency Adjustment Authorizations). Scans of the specifications must be in color, bookmarked pdfs, with a minimum resolution of 200 dpi.

1.8 EXTRA STOCK REQUIREMENTS

- A. Extra stock materials are to be provided.
 1. Each Finish paint type and color – 2 Gallons Each
 2. Vinyl floor primary type – 5 boxes.
 3. Ceiling Tile - 5 boxes.
 4. Extra belts specified on the Mechanical drawings.
 5. Other products as specified.
- B. All extra stock is to be provided in new unopened containers.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Complete log of activities as indicated in attached Owner Training Log.
- B. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Complete log of activities.
 1. Provide instructors experienced in operation and maintenance procedures.
 2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 3. Schedule training with Owner, with at least seven days' advance notice.
 4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
 5. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
 - a. System design and operational philosophy.
 - b. Review of documentation.
 - c. Operations.

- d. Adjustments.
- e. Troubleshooting.
- f. Maintenance.
- g. Repair.

C. As part of the Close-Out package, submit a completed Owner Training Log included in the Appendicies.

3.2 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - f. Sweep concrete floors broom clean in unoccupied spaces.
 - g. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - i. Remove labels that are not permanent.
 - j. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - (a) Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - (b) Replace parts subject to unusual operating conditions.
 - (c) Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - (d) Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - (e) Clean ducts, blowers, and coils if units were operated without filters during construction.
 - (f) Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - (g) Leave Project clean and ready for occupancy.
 - 2. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.3 CLOSE OUT CHECKLIST

- A. Provide information as outlined in attached Close-out Document Checklist (Appendix 5):
 - 1. Close-out Checklist - East Bay High School Addition.
 - a. Note: submittal of close out documents is a requirement to acheive Final Completion.
 - 2.

END OF SECTION

SECTION 03 3600 - POLISHED CONCRETE FLOOR FINISHES

PART 1 – GENERAL

- 1.1 SECTION INCLUDES- THIS SECTION INCLUDES THE FOLLOWING.
 - A. Polished Concrete specifications, concrete finishing consulting, contractor notes and tips.
- 1.2 SUBMITTALS
 - A. Product data: To be supplied by SCC - Southland Concrete Creations.
- 1.3 QUALITY ASSURANCE
 - A. Installer Qualifications: Concrete polishing is to be completed by Southland Concrete Creations. 941-721-4900
 - B. Verify the concrete finisher is qualified to provide and acceptable slab according to section 03 3000 and the SCC Concrete Finishing Suggestions.
 - C. Protection:
 1. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential.
 2. All hydraulic powered equipment must be diapered to avoid staining of the concrete.
 3. Check all tires for debris especially screws before driving on the concrete.
 4. Protect individual work areas from damage using a breathable type of floor protection. Within the first 20 days of new concrete placement do not leave floor protection on any one spot for more than 12 hours.
 5. No trade will park vehicles on the inside slab.
 - a. If necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.
 6. No pipe cutting machine will be used on the inside floor slab.
 7. Steel will not be placed on interior slab to avoid rust staining.
 8. Acids and acidic detergents will not come into contact with slab.
 9. All trades informed that the slab must be protected at all times.
 - D. Follow the suggestions given in the Southland Concrete Creations "GC Notes Brochure"
 - E. Mock-Ups: Minimum of a 6'x6' mock-up is to be approved for acceptance of concrete conditions to meet expectations.
 1. Provide the mock up in the gym.
- 1.4 CONFERENCE: MANDATORY PRE-SLAB AND PRE-INSTALLATION CONFERENCE:
 - A. Conduct conference with all subcontractors involved with the concrete pour. Mandatory to this meeting will be the Contractor, Polishing Contractor and the Concrete Finisher.
 - B. Use the Southland Concrete Creations "GC Notes Brochure" during the conference.
- 1.5 DELIVERY, STORAGE AND HANDLING
 - A. Deliver materials in original containers, with seal's unbroken, bearing manufacturer labels indicating brand name and directions for storage.
 - B. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.
- 1.6 PROJECT CONDITIONS
 - A. Environmental limitations:
 1. Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.
 - B. Concrete Floor Flatness rating recommended at least 40
 - C. Concrete Floor Levelness rating recommended at least 35 excluding drains and sloped floors
 - D. Concrete must be cured a minimum of 21 days before final polishing steps. If this presents a scheduling issue consult with Southland Concrete Creations.
 - E. Close areas to traffic during floor application. If this presents a scheduling issue consult with Southland Concrete Creations.

PART 2 – PRODUCTS

- 2.1 MATERIALS AND MANUFACTURERS
 - A. Hardening/densification:
 1. SCC Densifier
 - B. Pore Filler:
 1. SCC Pore Filler
 - C. Penetrating Color Dye:
 1. SCC Color Dye
 - D. Penetrating Stain Guard

- 1. SCC Stain Guard.
- E. Polyurea Joint Filler:
 - 1. SCC Joint filler
 - a. Shore 80 - 85.
- F. Patching and crack filler
 - 1. SCC Patching and crack filler.

PART 3 - EXECUTION

- 3.1 SURFACE CONDITIONS:
 - A. Examine substrate. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.
 - B. Verify that base slab meet finish and surface profile requirements in Division 3 Section "Cast-In-Place Concrete," Project Conditions above, and SCC "GC Notes Brochure".
- 3.2 APPLICATION
 - A. Polish according using the "SCC Polished Concrete System" to the following conditions.
 - 1. Surface Cut:
 - a. Grade 3 grind - Exposing heavy stone aggregate.
 - 2. Sheen Level:
 - a. Class 2 shine – Medium gloss finish (800 grit).
 - 3. Fill all control joints, saw cuts and expansion joints using SCC polyurea joint filler.
 - 4. Fill holes and divots in the concrete using SCC patch materials matching as close as possible to the concrete color.
 - 5. Fill cracks using SCC crack fill matching as close as possible to the concrete color.
 - 6. Apply SCC pore filler to fill 90% of pores.
 - 7. Apply SCC densifier to rejection.
 - 8. Apply and burnish SCC Stain Guard to polished concrete floor.
- 3.3 WORKMANSHIP AND CLEANING:
 - A. The premises shall be kept clean and free of debris at all times.
 - B. Remove spatter from adjoining surfaces, as necessary.
- 3.4 PROTECTION:
 - A. Protect floor with breathable protection.

END OF SECTION

SECTION 04 2613 - MASONRY VENEER

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Clay facing brick.
 - B. Mortar and grout.
 - C. Reinforcement and anchorage.
 - D. Flashings.
 - E. Installation of lintels.
 - F. Accessories.
- 1.2 RELATED REQUIREMENTS
 - A. Section 04 2000 - Concrete Unit Masonry.
 - B. Section 05 4000 - Cold-Formed Metal Framing: Steel stud backup for masonry veneer.
 - C. Section 05 5000 - Metal Fabrications: Loose steel lintels.
 - D. Section 07 6200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
 - E. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.
- 1.3 REFERENCE STANDARDS
 - A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - B. ASTM C91/C91M - Standard Specification for Masonry Cement.
 - C. ASTM C150/C150M - Standard Specification for Portland Cement.
 - D. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - E. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale).
 - F. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing.
 - G. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls.
 - H. BIA Technical Notes No. 46 - Maintenance of Brick Masonry.
- 1.4 ADMINISTRATIVE REQUIREMENTS
 - A. Preinstallation Meeting: Convene one week before starting work of this section.
- 1.5 SUBMITTALS
 - A. See Section 01 3300 -Submittal Procedures.
 - B. Product Data: Provide data for fabricated wire reinforcement and other accessories.
 - C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
 - D. Shop Drawings: Provide Shop Drawings identifying locations of masonry control joints, weep hole location and spacing, cavity drainage material, and through-wall flashing. Shop drawings for through-wall flashing shall depict fastening termination points of flashing within the wall cavity, use of termination bar, hemmed exposed edges of sheet metal, sealed end dams, flashing laps and related sealing requirements.
- 1.6 MOCK-UP
 - A. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar and accessories and structural backup in mock-up.
 1. Mock-up must be approved prior to ordering all brick required for job.
 2. Manufacturer is required to visit site and can adjust the composition of the 'mock-up' brick blend based on his/her observations to better fit the existing campus. Variations of percentages and colors shall be identified and presented to Owner and Architect for acceptance.
 3. Owner and Architect shall have the ability to accept or reject the mock-up based on compatibility with the existing campus.
 4. Mock-up shall include an entire window assembly to demonstrate how the cavity wall construction is to be integrated with the wall fenestration and through-wall flashing installation.
 - B. Mock-up may remain as part of the Work.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- 1.8 FIELD CONDITIONS
 - A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
 - B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.1 BRICK UNITS

- A. Manufacturers:
 - 1. Meridian Brick LLC; Red Semi-Smooth Flashed Modular: www.meridianbrick.com/#sle.
 - a. Basis of Design Product.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M Type N.
 - 1. Colored Mortar: Premixed cement as required to match Wilder Architecture, Inc.'s color sample to match existing after cleaned.
- B. Portland Cement: ASTM C 150, Type I or II; color as required to produce approved color sample.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Water: Clean and potable.

2.3 REINFORCEMENT AND ANCHORAGE

- A. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 1. Anchor plates: Not less than 0.105 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
 - 3. Vertical adjustment: Not less than 3-1/2 inches.
- B. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

2.4 FLASHINGS

- A. Metal Flashing Materials: Copper, as specified in Section 07 6200.
- B. Flashing shall be extended to the outer face of the masonry veneer and turned down over the face of the brick a minimum of 3/4". All exposed edges of the flashing shall be hemmed and outside corners shall be rounded.
- C. Flashing shall be set in a bed of sealant and a tooled sealant cove bead applied between the bottom exposed surface of the flashing and the brick.
- D. Rubberized Asphalt Flashing Materials: Flexible Flashing, as specified in Section 07650.

2.5 ACCESSORIES

- A. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
- B. Weeps:
 - 1. Type: Preformed aluminum vents with sloping louvers.
- C. Cavity Vents:
 - 1. Type: Polyester mesh.
- D. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Panels installed at flashing locations.
 - a. Manufacturers:
 - 1) Mortar Net USA, Ltd; Mortar Net with Insect Barrier: www.mortarnet.com.
- E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Brick Units:
 - 1. Bond: Running Bond.
 - a. Match the existing conditions at the original campus buildings.

2. Coursing: Three units and three mortar joints to equal 8 inches.
3. Mortar Joints: Concave.

3.3 PLACING AND BONDING

- A. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- B. Remove excess mortar as work progresses.
- C. Interlock intersections and external corners.
- D. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- E. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- F. Isolate top joint of masonry veneer from horizontal structural framing members or support angles with compressible joint filler.

3.4 WEEPS/CAVITY VENTS

- A. Install weeps in veneer walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
- B. Install cavity vents in veneer walls at 32 inches on center horizontally below shelf angles and lintels and at top of walls.

3.5 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.6 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Lap joint reinforcement ends minimum 6 inches.
- D. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 36 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- E. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.7 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 1 inch, minimum, to form watertight pan at non-masonry construction.
 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.8 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Form expansion joint as detailed on drawings.

3.9 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

3.10 CUTTING AND FITTING

- A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.11 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.12 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 04 7200 - CAST STONE MASONRY

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Units required are:
 - 1. Exterior wall units, including wall caps.
 - 2. Other items indicated on drawings.
- 1.2 RELATED REQUIREMENTS
 - A. Section 04 2000 - Unit Masonry: Installation of cast stone in conjunction with masonry.
 - B. Section 07 9005 - JOINT SEALERS: Materials and execution methods for sealing soft joints in cast stone work.
- 1.3 REFERENCE STANDARDS
 - A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - B. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
 - D. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - E. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
 - F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - G. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
 - H. ASTM C150/C150M - Standard Specification for Portland Cement.
 - I. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - J. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
 - K. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.
 - L. ASTM C1364 - Standard Specification for Architectural Cast Stone.
- 1.4 SUBMITTALS
 - A. See Section 01330 - Submittal Procedures.
 - B. Product Data: Test results of cast stone components made previously by the manufacturer.
 - 1. Include one copy of ASTM C1364 for Wilder Architecture, Inc.'s use.
 - C. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.
 - D. Mortar Color Selection Samples.
- 1.5 QUALITY ASSURANCE
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.
 - B. Number each piece individually to match shop drawings and schedule.
 - C. Store cast stone components and installation materials in accordance with manufacturer's instructions.
 - D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
 - E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
 - F. Store mortar materials where contamination can be avoided.
 - G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

PART 2 PRODUCTS

- 2.1 MATERIALS
 - A. Portland Cement: ASTM C150/C150M.
 - 1. For Mortar: Type I or II, except Type III may be used in cold weather.
 - B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.
 - C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.
 - D. Pigments: ASTM C979, inorganic iron oxides; do not use carbon black.
 - E. Admixtures: ASTM C494/C494M.

- F. Water: Potable.
- G. Reinforcing Bars: ASTM A615/A615M, Grade 40 (40,000 psi), deformed bars, galvanized.
 - 1. Galvanized in accordance with ASTM A767/A767M, Class I.
- H. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.
- I. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.
- J. Shelf Angles and Similar Structural Items: Hot-dip galvanized steel per ASTM A123/A123M, of shapes and sizes as required for conditions.
- K. Mortar: Portland cement-lime, ASTM C270, Type N; do not use masonry cement.
- L. Sealant: As specified in Section 07920 - Joint Sealants.
- M. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine construction to receive cast stone components. Notify Wilder Architecture, Inc. if construction is not acceptable.
- B. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

- A. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 2000.
- B. Mechanically anchor cast stone units indicated; set remainder in mortar.
 - 1. Anchorage indicated in the drawings.
- C. Setting:
 - 1. Drench cast stone components with clear, running water immediately before installation.
 - 2. Set units in a full bed of mortar unless otherwise indicated.
 - 3. Fill vertical joints with mortar.
 - 4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3.3 CLEANING

- A. Clean completed exposed cast stone after mortar is thoroughly set and cured.
 - 1. Wet surfaces with water before applying cleaner.
 - 2. Apply cleaner to cast stone in accordance with manufacturer's instructions.
 - 3. Remove cleaner promptly by rinsing thoroughly with clear water.
 - 4. Do not use acidic cleaners.

3.4 PROTECTION

- A. Protect completed work from damage.
- B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

END OF SECTION

SECTION 05 5000 - METAL FABRICATIONS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Shop fabricated steel and aluminum items.
- 1.2 SUMMARY
 - A. This Section includes the following:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Aluminum sun shades.
 - 4. Slotted Channel Framing and Accessories.
 - 5. Ledger Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking, joists, and masonry; prime paint finish.
 - 6. Lintels: As detailed; prime paint finish.
 - 7. Toilet Partitions Suspension Members: Steel angle sections; prime paint finish.
- 1.3 SUBMITTALS
 - A. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 1. Provide templates for anchors and bolts specified for installation under other Sections.
 - 2. Provide layouts of slotted channel framing, indicating threaded rod locations and accessories used to achieve design intent. Indicate the connections required but not identified in the documents such as splices.
- 1.4 QUALITY ASSURANCE
 - A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
 - B. Basic Metal Requirements
 - 1. Galvanic Action: Adhere to the requirements of ASTM G82 - 98
- 1.5 PROJECT CONDITIONS
 - A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.
- 1.6 COORDINATION
 - A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

- 2.1 METALS, GENERAL
 - A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- 2.2 FERROUS METALS
 - A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
 - C. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.

- D. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- E. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210 (ASTM B210M), 6063 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211 (ASTM B211M), 6061 alloy, T6 temper.
- E. Aluminum-Alloy Sand Castings: ASTM B26.
- F. Aluminum-Alloy Die Castings: ASTM B85.
- G. Bolts, Nuts, and Washers: Stainless steel.
- H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.4 PAINT

- A. Galvanizing Repair Paint: High-zinc-dust-content paint for reglazing welds in steel, complying with SSPC-Paint 20.
- B. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FASTENERS

- A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

2.6 GROUT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 CONCRETE FILL

- A. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.8 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Shear and punch metals cleanly and accurately. Remove burrs.
- C. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
 - 1. Fully seal all welded joints to prevent avenues for moisture migration.
 - 2. Seal-weld joints exposed to the exterior.
- H. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- I. Remove sharp or rough areas on exposed traffic surfaces.

- J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.9 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.
- B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches wide by 1/4 inch thick by 8 inches long at 24 inches o.c., unless otherwise indicated.
 - 2. Furnish inserts if units must be installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.

2.10 PIPE BOLLARDS

- A. Fabricate pipe bollards from Schedule 80 steel pipe.

2.11 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A 123, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

2.13 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Anodized Aluminum.
- B. Interior Aluminum Surfaces: Anodized Aluminum.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

3.3 INSTALLING PIPE BOLLARDS

- A. Anchor bollards in concrete in formed or core-drilled holes not less than 36 inches deep and 24 inches in diameter. After bollards have been inserted into holes, fill annular space surrounding bollard solidly with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- B. Bollards shall be 6" in diameter by 80 inches long, with top 48" above floor or grade and 32" of the Bollard material embedded in concrete.
- C. Fill bollards solidly with concrete, with a crowned concrete top.
- D. Provide a flexible soft top Dome Bollard Cap (6" high).
 - 1. PVC Vinyl - Color selected by Architect.

3.4 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 06 1000 - ROUGH CARPENTRY

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Roofing nailers.
 - B. Roofing curbs.
 - C. Preservative treated wood materials.
 - D. Data and electrical room mounting boards.
 - E. Concealed wood blocking, nailers, and supports.
- 1.2 RELATED REQUIREMENTS
 - A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
 - B. Section 09 2116 - Gypsum Board Assemblies: Gypsum-based sheathing.
- 1.3 REFERENCE STANDARDS
 - A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - D. AWWPA U1 - Use Category System: User Specification for Treated Wood.
 - E. PS 1 - Structural Plywood.
 - F. PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
 - G. PS 20 - American Softwood Lumber Standard.
 - H. SPIB (GR) - Grading Rules.
- 1.4 SUBMITTALS
 - A. See Section 01 3300 - Submittal Procedures.
 - B. Product Data: Provide technical data on application instructions and lumber provided.
 - C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
 - D. Certification: Form for each different product made of sustainably harvested wood (FSC certification).
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

- 2.1 GENERAL REQUIREMENTS
 - A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Douglas Fir-Larch, unless otherwise indicated.
 - 2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - B. Provide wood harvested in the state of Florida.
 - C. Provide sustainably harvested wood.
- 2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS
 - A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
 - B. Sizes: Nominal sizes as indicated on drawings, S4S.
 - C. Moisture Content: S-dry or MC19.
 - D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.
- 2.3 CONSTRUCTION PANELS
 - A. Roof Sheathing: Any PS 2 type, rated Structural I Sheathing.
 - 1. Bond Classification: Exterior.
 - 2. Span Rating: 60.
 - 3. Performance Category: 5/8 PERF CAT.

- B. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.4 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Stainless steel for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 - 3. Anchors: Toggle bolt type for anchorage to hollow masonry.
- B. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
 - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
- C. Self-Adhering Membrane Separator: where treated wood may induce galvanic corrosion with adjacent metals (aluminum, carbon steel, and coated carbon steel) provide separator membrane.

2.5 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
 - 2. The chemical treatment used shall not promote corrosion when in contact with aluminum, carbon steel, steel roof decking, and cold-formed metal faming including when the galvanized coating is nicked and/or penetrated by fasteners.
- B. Preservative Pressure Treatment of Lumber Above Grade: AWWA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - 1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - a. Treat lumber exposed to weather.
 - 2. Treat lumber in contact with roofing, flashing, or waterproofing.
 - 3. Treat lumber in contact with masonry or concrete.
 - 4. Treat lumber less than 18 inches above grade.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.3 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- F. Provide the following specific nonstructural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.

- 6. Wall-mounted door stops.

3.4 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

3.5 INSTALLATION OF CONSTRUCTION PANELS

- A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
 - 1. Nail panels to framing; staples are not permitted.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.

3.6 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.7 CLEANING

- A. Waste Disposal: See Section 01 7419 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 4100 - PLASTIC LAMINATE CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Extent of plastic laminate casework is indicated on Drawings. Work includes:
 - 1. Plastic laminate finished casework.
 - 2. Plastic laminate countertops.
 - 3. Solid-surfacing material countertops.
 - 4. Cabinet hardware.

1.3 QUALITY ASSURANCE

- A. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards, Illustrated, 8th Edition, Version 1.0, 2003", Section 400, published by the Architectural Woodwork Institute (AWI), except as otherwise indicated.

1.4 SUBMITTALS

- A. Quality Certification: Submit manufacturer's (Fabricator's) certification, stating that the fabricated work complies with quality grades and other requirements indicated.
- B. Shop Drawings: Submit shop drawings showing location of each item, dimensioned plans and elevations, large scale casework sections and details, attachment devices, and other components.
- C. Cabinet hardware: one unit of each type and finish.
- D. Plastic laminate: manufacturer's sample chain.
- E. Solid-surfacing materials, 2 inches square.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protect casework during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
- B. Do not deliver casework until painting, wetwork, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, casework must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

1.6 PROJECT CONDITIONS

- A. Conditioning: Installer shall advise Contractor of temperature and humidity requirements for casework installation areas. Do not install casework until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed casework within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. The fabricator of casework shall determine optimum moisture content and required temperature and humidity conditions.
- C. Field measurements: Where casework is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing casework; show recorded measurements on approved shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of work.

PART 2 - PRODUCTS

2.1 BASIC MATERIALS AND FABRICATION METHODS

- A. Plastic Laminate: Comply with NEMA LD-3 for type, thickness, color, pattern, and finish indicated for each application. Provide plastic laminate by one of the following; color selection by Architect.
 - 1. Formica.
 - 2. Nevamar.
 - 3. Wilsonart.
- B. Acrylic Latex Sealant with Silicone: Colored acrylic latex caulk with silicone for sealing joints between casework and building and between countertops and backsplashes. Color shall be selected by Architect to match color of laminated plastic surfaces. All products used in this section shall comply with the limits for void content as described in Section 01352 paragraph 2.5. Verify the void content of the following products:
 - 1. "Form Fill Adhesive Caulk".
 - 2. "ColorRITE Caulking Spectrum".
 - 3. "Color Flex"; Kämpel.

- C. Lumber and Panel Materials: Comply with AWi Section 400-G-8 requirements for lumber and panel product requirements, unless specific core material is identified herein.
1. Panel materials for cabinet bodies, doors, drawer fronts, and countertops shall be softwood veneer core plywood as follows. No particleboard, MDF/fiberboard shall be used as a substrate for laminated plastic.
 - a. Plywood shall be made:
 - 1) 95% void-free.
 - 2) 3/4" thick / Seven (7) Ply.
 - 3) 3/8" thick / Three (3) Ply.
 - 4) Exposure I: Exterior waterproof glue.
 - 5) Classification: APA Group I, (Fir, Odorless Virola)
 - 6) Appearance Grades: (Installation Applications)
 - (a) A-A Exposed & Semi-Exposed Surface Laminate Base: Two (2) Sides
 - (b) A-C Exposed & Semi-Exposed Surface Laminate Base / Concealed Surface Laminate Base
 - b. Plywood to be used for Casework Sub-Base Platform:
 - 1) 95% void-free.
 - 2) 3/4" thick / Seven (7) Ply.
 - 3) Exposure I: Exterior waterproof glue.
 - 4) Classification: APA Group I, (Southern Pine)
 - 5) Pressure Treated to 0.25-retention.
 - 6) Appearance Grade: (Installation Application).
 - (a) B-C Exposed Surface for Vinyl Base I Concealed Surface
 - D. Solid-Surfacing Material: Homogenous solid sheets of quartz-based fabricated stone.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Caesarstone USA, Inc.: "Caesarstone."
 - b. Cambria: "Cambria"
 - c. Cosentino: "Silestone."
 - d. E.I. du Pont de Nemours and Company: "Zodiaq."
 2. Type: Premium Grade.
 3. Colors and Patterns: As selected by Architect from manufacturer's full range.
 4. Finish: Polished.
 5. Edges: Beveled.
 6. Corners: Rounded.
 7. Location(s): Bathrooms, Office(s), and Kitchen.
 - a. Refer to drawings.
 - E. Design and Construction Features: Comply with details shown for profile and construction of casework; and, where not otherwise shown, comply with applicable quality standards.
 - F. Shop-Cut Openings: Fabricate casework with shop-cut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar item openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.

2.2 PLASTIC LAMINATE FINISHED CASEWORK

- A. Grade: AWi Custom Grade.
- B. Cabinet Construction: Flush overlay, conforming to AWi Section 400-G-7. Conform to the following requirements:
1. Cabinet Body Sides, Dividers, Tops, Bottoms, Fixed Shelves and Stretchers: Not less than 3/4" thick. Provide stretchers at top of base cabinet.
 2. All adjustable shelves shall be constructed using minimum 3/4" thick 9-ply Luan veneer plywood. Shelves shall have GP-50 type laminated plastic on both faces, and it shall be applied in the same machine direction on both faces. Shelves shall be edge banded with GP-50 type laminated plastic on all 4 sides.
 3. Backs: Not less than 1/4" thick.
 4. Drawer Fronts: Not less than 3/4" thick.
 5. Drawers: Sides, subfronts and backs: Not less than W' thick; bottoms: not less than 1/4" thick. Provide box type construction with front, bottom and back lock shouldered in sides and secured with glue and mechanical fasteners.
 6. Doors: Not less than 3/4" thick.
 7. Joinery: Rabbet backs flush into end panels and secure with concealed mechanical fasteners. Connect wall cabinet tops and bottoms and base cabinet bottoms and stretchers to ends and dividers by means of mechanical fasteners. Rabbet tops, bottoms and backs into end panels.
 8. Subbase: Not less than 1-1/2" thick, 4-1/2" high, recessed 2-1/2" from cabinet fronts and exposed ends. Cover with base as scheduled on drawings.

- 9. All base and wall cabinets wider than 36 inches shall have a full height center divider. Omit divider in base cabinets containing sinks.
 - C. Exposed Surfaces: Provide high pressure laminate in grades indicated for the following types of surfaces:
 - 1. Horizontal surfaces: GP-50 (0.050" nominal thickness).
 - 2. Vertical Surfaces: GP-28 (0.028" nominal thickness). Doors must have same laminate on both faces.
 - D. Semi-Exposed Surfaces: Finish semi-exposed surfaces as follows, unless otherwise indicated.
 - 1. Plastic laminate, CL-20; white in color.
 - E. Concealed Surfaces: Finish concealed surfaces without plastic laminate with two coats of shellac or clear sanding sealer.
 - F. Fabricate all exposed edges of casework, including edges of doors and drawers when open, with matching plastic laminate.
 - G. Provide backsplashes for millwork adjacent to walls.
- 2.3 PLASTIC LAMINATE COUNTERTOPS
- A. General: Except as otherwise indicated, provide separate plastic laminate countertops (installed on other casework or other support system as indicated) to comply with requirements for casework for plastic laminate finish.
 - B. Grade: AWI custom grade.
 - C. All countertops containing plumbing fixtures shall be constructed with shop sanded exterior grade plywood, minimum 3/4" thick. Edge details shall conform to AWJ Section 400C, with 1-1/2" wide face.
 - D. Standard .02" phenolic back-up sheet required wherever unsupported area exceeds 6 sq. ft. and core is 3/4" thick; 8 sq. ft. and core is 1" thick; 10 sq. ft. and core is 1-1/8" or thicker.
 - E. There shall be no seams in laminate within 24" of sink cutouts.
 - F. Wire Management Grommets: Provide where indicated on drawings.
 - 1. Grommet sets shall include a plastic grommet to fit a 2" diameter hole, with a retractable, self-storing slot cover. Color: black.
 - 2. Manufacturer: Outwater Plastics Industries, Inc., part #31 BK, or Doug Mockett & Company, Inc., part no. TG.
- 2.4 SOLID SURFACING - MATERIAL COUNTERTOPS
- A. Grade: Custom
 - B. Solid Surfacing - Material Thickness: 3/4 inch.
 - C. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing- material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate tops with shop-applied edges of materials and configuration indicated.
 - 2. Fabricate tops with loose backsplashes for field application where indicated on drawings.
 - D. Drill holes in countertops for plumbing fittings in shop.
 - E. Provide adequate support in the cabinet base for the additional weight of solid surfacing.
 - 1. Where seams exist supports shall not allow the the surfacing to move out of a flush, finished plane.
- 2.5 CABINET HARDWARE
- A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for units which are specified as "door hardware" in other sections of these specifications.
 - B. Hardware Standards: Except as otherwise indicated, comply with ANSI A156.9 "American National Standard for Cabinet Hardware".
 - 1. Quality Level: Type 2 (institutional), unless otherwise indicated.
 - 2. Quality Certification: Where available, provide cabinet hardware bearing the BHMA certification label, affixed either to hardware or its packaging, showing compliance with BHMA Cabinet Hardware Standard 201.
 - C. Cabinet Hardware Schedule: Refer to schedule included as last pages of this section for specific hardware and accessory items required for casework.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Condition casework to average prevailing humidity conditions in installation areas prior to installing.
- B. Deliver concrete inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.
- C. Prior to installation of casework, examine shop fabricated work for completion, and complete work as required, including removal of packing.

3.2 INSTALLATION

- A. Installer: The installation of all work of this section shall be by the fabricator of the plastic laminate casework.

- B. Install the work plumb, level, true and straight with no distortions. Shims required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level (including countertops).
- C. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.
- D. Anchor casework to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation.
- E. Install without distortion so that doors and drawers will fit openings properly and be accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.
- F. Countertops: Anchor securely to base units and other support systems as indicated.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
- G. Sealant: Caulk exposed joints between casework and building and between laminated plastic countertops and backsplashes with colored acrylic latex caulk with silicone. Color shall be selected by Architect to match color of laminated plastic surfaces.

3.3 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

- A. Repair damaged and defective casework wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace casework. Adjust joinery for uniform appearance.
- B. Clean hardware, lubricate and make final adjustments for proper operation.
- C. Clean casework on exposed and semi-exposed surfaces.
- D. Protection: Installer of casework shall advise Contractor of procedures required to protect casework during remainder of construction period to ensure that work will be without damage or deterioration at time of acceptance.

3.4 CABINET HARDWARE SCHEDULE

- A. Finish: Of all hardware shall be US26 polished chrome unless noted otherwise.
- B. Manufacturers: Provide products by the following manufacturers or approved equal.
 - 1. Adjustable shelving supports - K & V (Knappe & Vogt), #345, for 5 mm hole; nickel-plated steel.
 - 2. Hinges - 5 knuckle, 2-3/4" reveal overlay type with hospital tips and adjustable screw holes, US20 polished chrome finish.
 - a. Rockford #375
 - b. or, Weber Knapp #M25R4-0-9-091.
 - 3. Catches - Stanley #SP41, magnetic type (US28).
 - 4. Pulls - Sugatsune America #EC-100/M EC Series Handle, 303 stainless steel, mirror finish.
 - 5. Box and File Drawer Slides - Knappe & Vogt No. 8400 (100-pound class) telescoping, full extension, ball bearing slide; anochrome finish.
 - 6. File Drawer File Brackets - Kinetron Corporation Kine Flex file bracket system #KHFB with top mount movable brackets that slide over edge of drawer frame, and 5/8" file bars. Provide 1 set per drawer.
 - 7. Locks - Key operated, pintumbler, dead bolt type. Provide National Locks or Corbin Cabinet Lock, US 26 finish.
 - 8. Drawers:
 - a. 1 set.....Slides.....8400
 - b. 1.....Pull.....EC-100/M
 - c. 1.....Lock.....(where indicated on drawings: National CB179)
 - 9. Cabinet Doors (single):
 - a. (Doors 48" high and over shall carry 3 or more hinges per door)
 - b. 1 pair.....Hinge.....375
 - c. 1.....Catch.....41
 - d. 1.....Pull.....EC-100/M
 - e. 1.....Lock.....(where indicated on drawings: National C8173 x strike)
 - 10. Cabinet Doors (pairs):
 - a. (Doors 48" high and over shall carry 3 or more hinges per door.)
 - b. 2 pair.....Hinges.....375
 - c. 2.....Catch.....41
 - d. 2.....Pulls.....EC-100/M
 - e. 1.....Lock.....(where indicated on drawings: National C8173 x strike)
 - 11. Door Locks
 - a. Key all personnel lockers individually. Provide 2 keys per lock; provide master key system.

12. Coat Hooks for Personnel Lockers: Sugatsune America, Inc. polished stainless steel hook No. EL-25.
Provide one hook on inside of every personnel locker door; mount at same height as clothes rod and center hook on door. Secure with stainless steel screws.
13. Clothes Rods for Personnel Lockers: Knape and Vogt No. 750-1 chrome-look round steel tubing, 1-1/16" O.D.; wall thickness .075". Mounting Flanges: Knape and Vogt No. 734 CHR - chrome-look finish.

END OF SECTION

SECTION 07 1300 - SHEET WATERPROOFING

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Self-adhered modified bituminous sheet membrane.
- 1.2 ABBREVIATIONS
 - A. NRCA - National Roofing Contractors Association.
- 1.3 REFERENCE STANDARDS
 - A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension.
 - B. ASTM D570 - Standard Test Method for Water Absorption of Plastics.
 - C. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
 - D. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
 - E. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.
 - F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
 - G. NRCA (WM) - The NRCA Waterproofing Manual.
- 1.4 SUBMITTALS
 - A. Product Data: Provide data for membrane.
 - B. Certificate: Certify that products meet or exceed specified requirements.
 - C. Manufacturer's Installation Instructions: Indicate special procedures.
 - D. Manufacturer's qualification statement.
 - E. Installer's qualification statement.
 - F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Hillsborough County's name and registered with manufacturer.
- 1.5 QUALITY ASSURANCE
- 1.6 MOCK-UPS
 - A. Construct mock-up consisting of 100 sq ft of horizontal and vertical sheet waterproofing panel; to represent finished work including internal and external corners, seam jointing, attachment method, and ____.
 - B. Mock-up may remain as part of work.
- 1.7 FIELD CONDITIONS
 - A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.
- 1.8 WARRANTY
 - A. General Contractor to correct defective Work within period of five years after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Hillsborough County.

PART 2 PRODUCTS

- 2.1 SHEET WATERPROOFING MATERIALS
 - A. Self-Adhered Modified Bituminous Sheet Membrane:
 - 1. Thickness: 60 mil, 0.060 inch, minimum.
 - 2. Sheet Width: 36 inches, minimum.
 - 3. Tensile Strength:
 - a. Film: 5,000 psi, minimum, measured in accordance with ASTM D882 and at grip-separation rate of 2 inches per minute.
 - b. Membrane: 325 psi, minimum, measured in accordance with ASTM D412 Method A, using die C and at spindle-separation rate of 2 inches per minute.
 - 4. Elongation at Break: 300 percent, minimum, measured in accordance with ASTM D412.
 - 5. Water Vapor Permeance: 0.05 perm, maximum, measured in accordance with ASTM E96/E96M.
 - 6. Adhesion: 150 psi, minimum, measured in accordance with ASTM D4541.
 - 7. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
 - 8. Hydrostatic Pressure Resistance: Membrane resists leakage for at least one hour from pressure equivalent to 200 feet head of water applied in accordance with test method ASTM D5385/D5385M.
 - 9. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
 - 10. Products:
 - a. Carlisle Coatings & Waterproofing Inc; MiraDRI 860/861: www.carlisleccw.com/#sle.

b. W. R. Meadows, Inc; MEL-ROL: www.wrmeadows.com/#sle.

1) Basis of Design.

2.2 ACCESSORIES

- A. Seaming Materials: As recommended by membrane manufacturer.
- B. Membrane Sealant: As recommended by membrane manufacturer.
- C. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
- D. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
 - 1. Composition: Dimpled polystyrene, polyethylene, or polypropylene core; polypropylene filter fabric.
 - 2. Thickness: 1/2 inch.
 - a. Products:
 - 1) W. R. Meadows, Inc; Mel-Drain 5012: www.wrmeadows.com/#sle.
- E. Cant Strips: Premolded composition material.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify that items penetrating surfaces to receive waterproofing are securely installed.
- D. Where existing conditions are responsibility of another installer, notify Wilder Architecture, Inc. of unsatisfactory conditions.
- E. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

3.3 INSTALLATION - MEMBRANE

- A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- B. Roll out membrane, and minimize wrinkles and bubbles.
- C. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.
- D. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- E. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.
- F. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- G. Seal membrane and flashings to adjoining surfaces.

3.4 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

- A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward; scribe and cut boards around projections, penetrations, and interruptions.
- B. Place protection board directly against drainage panel; butt joints, and scribe and cut boards around projections, penetrations, and interruptions.
- C. Adhere protection board to substrate with compatible adhesive.

3.5 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.

3.6 PROTECTION

- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 07 1600 - UNDERSLAB VAPOR RETARDER

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Surface preparation.
 - B. Application of underslab vaporproofing membrane.
- 1.2 RELATED SECTIONS
 - A. Section 03 3000 - Cast-in-Place Concrete.
- 1.3 REFERENCES
 - A. American Society for Testing and Materials (ASTM)
 - 1. ASTM E 1745 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil Or Granular Fill Under Concrete Slabs.
 - 2. ASTM E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.
 - 3. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials.
 - 4. ASTM E 1643 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 - B. Florida Building Code
 - 1. Comply with Appendix E, Chapter 9 B-67 Florida Standard for Radon Resistant New Commercial Construction, Chapter E301 Construction Requirements for Passive Controls.
 - C. American Concrete Institute (ACI)
 - 1. ACI 302.1R-96 Vapor Barrier Component (plastic membrane) is not less than 15 mils thick.
- 1.4 SUBMITTALS
 - A. Comply with Section 01330 - Submittal Procedures.
 - B. Submit manufacturer's product data and application instructions.
 - C. Shop Drawings: indicate job-specific termination details, penetration details, and other applicable conditions.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
 - B. Store materials in a clean dry area in accordance with manufacturer's instructions.
 - C. Stack membrane on smooth ground or wood platform to eliminate warping.
 - D. Protect materials during handling and application to prevent damage or contamination.
- 1.6 ENVIRONMENTAL REQUIREMENTS
 - A. Product not intended for uses subject to abuse or permanent exposure to the elements.
 - B. Do not apply on frozen ground.

PART 2 PRODUCTS

- 2.1 MANUFACTURER
 - A. Manufacturer must have a minimum of 20 years experience manufacturing vapor barrier/retarder materials and show independent test results for minimum standards listed below.
- B. MATERIALS
 - 1. Plastic Vapor Retarder
 - a. Performance Based Specification: Vapor Retarder membrane must meet or exceed all requirements of ASTM E 1745 Classes A, B, & C.
 - 1) Minimum Permeance ASTM E 96: 0.3 perms or better
 - 2) Resistance to Organisms and Substrates in Contact with Soil ASTM E 154, Section 13: 0.051 Perms
 - 3) Tensile Strength: ASTM E 154, Section 9: 45.6 LBS. Force/Inch or better
 - 4) Puncture Resistance: ASTM D 1709, Method B: 2,200 Grams or better
 - 5) Water Vapor Retarder: ASTM E 1745: Meets or exceeds Class A, B & C
 - 6) Thickness of Retarder (plastic) ACI 302.1R-96: Not less than 15 mils.
 - b. Product: Basis of Design - Stego Industries, LLC Stego Wrap 15 mil or equal .
- C. ACCESSORIES
 - 1. Seam Tape
 - a. High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4 inches.
 - 2. Pipe Boots

- a. Construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's instructions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive membrane. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.
- B. Examine all slab-on-grade vapor retarder installation.
 1. Examine after steel reinforcement installation, prior to concrete placement.
 2. Manufacturer's technical representative should examine in addition to Owner's Inspector.
 3. Provide examination report prior to concrete placement shall be provided to the Installer, General Contractor, Owner and Architect within 5 days of each inspection..

3.2 SURFACE PREPARATION

- A. Prepare surfaces in accordance with manufacturers instructions.

3.3 APPLICATION

- A. Installation shall be in accordance with manufacturer's instructions and ASTM E 1643-98.
- B. Unroll vapor barrier with the longest dimension parallel with the direction of the pour.
- C. Lap vapor barrier over footings and seal to foundation walls.
- D. Overlap joints 12 inches and seal with manufacturer's tape.
- E. Seal all penetrations (including pipes) with manufacturer's pipe boot.
- F. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
- G. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 12 inches and taping all four sides with tape.

END OF SECTION

SECTION 07 1815 - CLEAR WATER REPELLENT SEALER

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and applying clear water repellent coating to all exterior masonry walls/surfaces.
- B. Work of this Section includes all labor, materials, equipment and services necessary to complete the installation of the water repellent inclusive but not limited to:
 - 1. Cast Stone - wainscot caps, window sills, and other cap locations.

1.2 REFERENCED STANDARDS

- A. The referenced standards listed below are considered part of the requirements listed in this section. If specific aspects of the standards do not apply, the Contractor shall identify the specific references in writing prior to beginning work. All requests for omission must be approved by the Architect.
 - 1. ASTM E 514 - Water Permeance of Masonry, Concrete Masonry Units
 - 2. ASTM C 67 - Sampling and Testing Brick and Structural Clay Tile, Part F "Absorption"
 - 3. ASTM D 4261 Surface Cleaning Concrete Unit Masonry for Coating;

1.3 DEFINITIONS

- A. Terminology as defined in the following standards apply to this section:
 - 1. ASTM D 16 Paint, Related Coatings, Materials, and Applications;
 - 2. ASTM E 284 Appearance;
 - 3. National Paint & Coatings Association (NPCA) Glossary of Terms as listed at the following URL:
www.paint.org/ind_info/terms.cfm;
- B. Design Standard: The paint/coating material specifically referenced by manufacturer's name/number, which determines the performance and quality requirements for materials referred in this Section.

1.4 SUBMITTALS

- A. Complete and submit the Label Analysis Form for water repellent material(s) submitted (excluding the Design Standard);
- B. Manufacturer's Information: Manufacturer's technical information including instructions for handling, storing, surface preparation application etc.
 - 1. Provide manufacturer's recommendation for protecting adjacent finishes during application.
- C. Pre-Job RILEM Water Uptake Testing - Prior to performing the work, submit a written report of testing (performed by the water repellent supplier or 3rd party) indicating results for each masonry substrate to be sealed. A minimum of one test per elevation and/or individual surface (brick, split-faced block, stone etc.). See Section 3.3 for testing procedures.
- D. Submit a letter from the water repellent manufacturer/supplier that confirms the applicator has been properly trained on the application requirements for the specific materials to be used.
- E. Post-Job Rilem Water Uptake Testing - After the work is complete, submit a written report of testing (performed by the water repellent supplier or 3rd party) indicating results for each sealed masonry substrate. A corresponding test shall be performed in each of the Pre-Job test locations.
- F. Errors, Omissions, and Other Discrepancies
 - 1. Submit all errors, omissions, and other discrepancies in contract documents to the Architect within 30 days of contract award for all work covered in this Section, other than the work that will not be uncovered until a later date. All such discrepancies shall be addressed and resolved, and the work plan modified, prior to beginning the initial and follow-up phases of work. Discrepancies that become apparent only after work is uncovered shall be identified at the earliest discoverable time and submitted for resolution.

1.5 QUALITY CONTROL

- A. Applicator Qualifications: A firm or individual must be approved by the water repellent manufacturer/supplier as outlined in Section 1.4, D.
- B. The contractor or applicator's designated Quality Control Person (QCP) shall maintain a daily log of work performed including materials used and square footage completed. In addition, project conditions should be logged for every day water repellent is applied.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.

4. VOC content.
 - B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.
- 1.7 WARRANTY
- A. The water repellent manufacturer shall furnish the School District of Hillsborough County a written labor and materials warranty. The warranty shall cover all walls/surfaces where the water repellent was applied. Warranty performance shall be verified based on the Post-Job testing (as tested using the RILEM Uptake Test outlined in Section 3.2). The warranty period is for five years from the Post-Job testing.
 - B. The water-repellent manufacturer shall be responsible for providing labor and material to seal walls/surfaces where the water repellent effectiveness does not meet the Post-Job testing results.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
- A. The Design Standard water repellent materials for this Section are manufactured by Degusa Corporation, specifically Chem-Trete.
 - B. Subject to compliance with product submittal/approval requirements, provide the product listed in this Section or an equivalent product, as determined by the Architect. Other manufacturers will be considered contingent upon their responsiveness to the requirements set forth in this Section (e.g. performance and warranty).
- 2.2 MATERIALS, GENERAL
- A. Source Limitations: Obtain all water repellent materials from the same manufacturer.
- 2.3 WATER REPELLENT MATERIALS
- A. Semi-Porous Substrates (Cast Stone, etc.)
 1. CHEM-TRETE® BSM 40 VOC - Clear, colorless liquid containing isobutyltrialkoxo silane in alcohol.

PART 3 - EXECUTION

- 3.1 EXAMINATION
- A. Examine substrates, areas, and conditions for compliance with requirements for water repellent application.
 1. Proceed with water repellent application only after unsatisfactory conditions have been corrected and surfaces receiving water repellent are thoroughly dry.
 2. Start of application will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
 3. Verify that surfaces are dry, free of visible efflorescence, loose particles, laitance, curing compounds, and other foreign matter that would block absorption of the water repellent.
 4. Verify masonry is compatible with coating. If not, notify Architect before proceeding.
 5. Verify that the curing of caulking and/or sealing materials is complete.
 6. Verify that the curing of tuck pointing mortar is complete.
- 3.2 MOCK-UP APPLICATION
- A. At least two weeks prior to the beginning of work, prepare at least a 3-ft. by 3-ft. area to be sprayed with the water repellent. The Architect will determine the location of the test area. Apply the water repellent in accordance with the manufacturer's recommendations for coverage rates.
 1. Manufacturer's technical representative shall approve the mock-up, including surface preparation, coverage rates, and testing.
 - B. After allowing five days for the sample to cure, perform testing as described in Section 3.3 on the treated area.
 - C. The Architect or designated representative shall be present for the application of the water repellent and the testing.
- 3.3 TESTING
- A. To determine if the water repellent is performing a "RILEM Water Uptake Test" procedure will be used. The treated area shall not allow the absorption of more than 1.0 milliliter (ml) of water for a period of 20 minutes. If an area absorbs more than 1.0 ml it will be considered deficient.
 1. All deficient areas shall have additional sealer applied and retested.
 2. Test results shall be documented in a written report that shall include the following (minimum):
 - a. Date;
 - b. Name of individual performing the test;
 - c. Brief description of test procedure; and,

- d. Location of each area and substrate tested with corresponding results
 - B. Coordination of Work: Review other Sections in which paint and exterior finishes are provided to ensure compatibility of the total system for various substrates. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.
- 3.4 PREPARATION
- A. Cleaning: Before applying water repellent, clean substrates to remove substances that could prevent proper penetration of the material. Special cleaning solutions or methods shall be approved in writing by the water repellent manufacturer/supplier. Typical cleaning methods involve pressure cleaning. The pressure shall be suitable to remove the deleterious substances, while not damaging or marring the substrate.
 - B. Material Preparation: Prepare water repellent materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
- 3.5 APPLICATION
- A. Provide adequate protection of glass, metal, and other non-porous substrates. The Contractor will be responsible to clean all surfaces, which are contaminated by the water repellent.
 - B. Provide adequate protection of plants, grass, and other vegetation. The Contractor shall be responsible for replacing all plants, grass, or vegetation damaged by the water repellent.
 - C. Apply water repellent according to manufacturer's written instructions and applied as supplied by the manufacturer without dilution or alternation.
 - D. Apply using low-pressure, airless spray equipment with a fan spray nozzle, flooding the surface to obtain uniform coverage unless otherwise recommended by the manufacturer.
 - 1. Follow manufacturer's recommendations for appropriate coverage rates unless the field tests determine that a heavier rate of application is necessary to meet the performance requirements.
 - E. In addition to the manufacturer's requirements for project conditions (ambient weather conditions, substrate dryness etc.), do not proceed with application if ambient temperature of surface exceeds 100°F during application. In addition, do not proceed with the application if precipitation has occurred within 48 hours prior to application or if rain is anticipated within 4 hours after application.
- 3.6 HOUSEKEEPING
- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

END OF SECTION

SECTION 07 2100 - BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Concealed thermal building insulation.
 - 2. Concealed acoustical building insulation.
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry Assemblies" for foamed-in-place masonry wall insulation.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of insulation product specified.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire- test-response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide insulation products by one of the following:
 - 1. Glass-Fiber Blanket Insulation
 - a. CertainTeed Corporation
 - b. Johns Manville Corporation
 - c. Knauf Fiber Glass
 - d. Owens Corning
 - 2. Polyisocyanurate Board Insulation:
 - a. Atlas Roofing Corporation
 - b. Dow Chemical Company
 - c. Rmax, Inc.
 - 3. Slag-Wool / Rock-Wool Fiber Sound Attenuation Insulation:
 - a. Fibrex, Inc.
 - b. Partek Insulations, Inc.
 - c. USG Interiors, Inc.

2.2 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.

- B. Faced, Glass-Fiber Blanket (Batt) Insulation: ASTM C 665, Type II (Blankets with kraft paper vapor retarder membrane facing on one face), Class C. Provide blankets with R-19 rating, approximately 6.25" thick.
 - 1. Strap to top chord of trusses, typ.
- C. Polyisocyanurate Board Insulation: Rigid, cellular polyisocyanurate thermal insulation with core faced on both sides with aluminum foil to comply with referenced standard and with other requirements indicated below:
 - 1. ASTM Standard: ASTM C 1289, Type 1, Class 1 or 2.
 - 2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 75 and 450, respectively, based on tests performed on unfaced core on thicknesses up to 4 inches.
 - 3. Conditioned R-value: 5.0 minimum, per ASTM C 1289 and ASTM C 518.
 - 4. Thickness: 3/4 - inch unless otherwise indicated on drawings.
- D. Unfaced Mineral-Fiber Blanket Insulation: Sound attenuation insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, Type I (blankets without membrane facing).
 - 1. Mineral-Fiber Type: Fibers manufactured from slag wool or rock wool.
 - 2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
 - 3. Thickness: provide width of the stud, or 3" at horizontal installations, unless otherwise indicated on drawings.
- E. Foam Sealant: at exterior soffit to seal building above masonry walls at trusses and plywood.
 - 1. DAP "Touch 'N Seal" No-Warp Foam sealant.
 - 2. Seal cracks and gaps up to 1-1/2".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Apply insulation to produce thickness indicated.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass - Fiber Blanket Insulation: Install as follows:
 - 1. Set kraft facing toward plywood roof sheathing.
 - 2. Place blankets in cavities formed by framing members to produce a friction fit between edge of insulation and framing members.
 - a. Provide galvanized chicken wire as required to hold insulation in place between roof trusses.
 - b. Or, provide woven polypropylene hanging straps.
 - 1) DiversiTech 710-100.
- C. Polyisocyanurate Board Insulation: Install as follows:
 - 1. Attach boards to masonry and concrete wall substrates by adhesive attachment. Seal joints between boards with aluminum foil tape.
 - 2. Provide a continuous plane of rigid insulation. Do not provide conduit and boxes in the same plane as the insulation.
- D. Slag-Wool / Rock-Wool Fiber Sound Attenuation Insulation
 - 1. Install in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3.5 PROTECTION

- A. General: Protect installed insulation and radiant barriers from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 3110 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes asphalt shingles for steep roofs.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 6 Section "Rough Carpentry" for wood sheathing and framing.
 - 2. Division 7 Section "Flashing and Sheet Metal" for step flashing, and other sheet metal work.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified, including details of construction relative to materials, dimensions of individual components, profiles, textures, and colors.
 - 1. Provide Florida Product Approval Acceptance Number and Installation instructions.
 - 2. Demonstrate compliance with the Wind Speed design criteria of the project.
- C. Samples for initial selection in the form of manufacturer's sample finishes showing the full range of colors and profiles available for each type of asphalt shingle indicated.
- D. Samples for verification in the form of 2 full-size units of each type of asphalt shingle indicated showing the full range of variations expected in these characteristics.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Classification: Where products with a fire-test-response classification are specified, provide asphalt shingles identical to those tested according to ASTM E 108 or UL 790 and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify each bundle of asphalt shingles with appropriate markings indicating fire-test-response classification of applicable testing and inspecting agency.
- B. Wind-Resistance-Test Characteristics: Where wind-resistant asphalt shingles are indicated, provide products identical to those tested according to ASTM D 3161 or UL 997 and passed. Identify each bundle of asphalt shingles with appropriate markings of applicable testing and inspecting agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's unopened bundles or containers with labels intact.
- B. Handle and store materials at Project site to prevent water damage, staining, or other physical damage. Store roll goods on end. Comply with manufacturer's recommendations for job-site storage, handling, and protection.

1.6 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installing asphalt shingles only when existing and forecasted weather conditions will permit work to be performed according to manufacturers' recommendations and warranty requirements, and when substrate is completely dry.

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty signed by manufacturer agreeing to repair or replace asphalt shingles that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, deformation or deterioration of asphalt shingles beyond normal weathering.
 - 1. Warranty Period: Manufacturer's standard but not less than 30 years after date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.
 - 1. Furnish 1 package of asphalt shingles, identical to those to be installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide asphalt shingles produced by one of the following; with architects approval for equal for use of product other than Basis of Design. Basis of Design is Timberlane Ultra, Color is Slate.
 - 1. Atlas Roofing Corp. - "StormMaster LM 40".
 - 2. CertainTeed Corporation - "Dimensional 40".
 - 3. GAF Building Materials Corporation - "Timberline Ultra".
 - 4. Owens-Corning Fiberglas Corp - "WeatherGuard 40 AR High Wind 110".

2.2 ASPHALT SHINGLES

- A. Colors, Blends, and Patterns: Where manufacturer's standard products are indicated, provide asphalt shingles with the following requirements:
 - 1. Provide Architect's selections from manufacturer's full range of colors, textures, and patterns for asphalt shingles of type indicated.
- B. Three-Dimensional, Fiberglass, Laminated Strip Shingles: Mineral-surfaced, self-sealing, laminated, multi-ply overlay construction, fiberglass-based, strip asphalt shingles, complying with both ASTM D 3018, Type I, and ASTM D 3462. Provide shingles with a Class A fire-test-response classification that pass the wind-resistance-test requirements of ASTM D 3161.
 - 1. Shingles must be algae-resistant
 - 2. Shingles must have Dade County Florida Product Control Approval.
- C. Hip and Ridge Shingles: Manufacturer's standard, factory-precut units to match asphalt shingles.

2.3 METAL FLASHING

- A. Vent Pipe Flashing: Lead conforming to ASTM B 749, Type L51121, at least 1/16 inch thick, unless otherwise indicated. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof extending at least 4 inches from pipe onto roof.

2.4 ACCESSORIES

- A. Underlayment: 40-mil (min.) peel and stick.
- B. Mineral-Surface, Organic-Felt Roll Roofing: Mineral-granular-surfaced, organic-felt-based, asphalt roll roofing, 36 inches wide, complying with ASTM D 249, Type I.
- C. Asphalt Plastic Cement: Nonasbestos fibrated asphalt cement, complying with ASTM D 4586.
- D. Nails: Hot-dip galvanized steel, 0.120-inch- diameter barbed shank, sharp-pointed, conventional roofing nails with a minimum 3/8-inch- diameter head and of sufficient length to penetrate 3/4 inch into solid decking or at least 1/8 inch through plywood sheathing.
 - 1. Where nails are in contact with flashing, prevent galvanic action by providing nails made from the same metal as that of the flashing.
- E. Staples: Not allowed.
- F. Fascia and Soffits: pre-finished.
 - 1. Soffit: V-groove soffit panel. "Envoy" aluminum soffit by Alcoa (or equal).
- G. Gutters and Downspouts: seamless aluminum. Kynar 500 finish (or equal).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate for compliance with requirements for substrates, installation tolerances, and other conditions affecting performance of asphalt shingles. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application. Cover knotholes or other minor voids in substrate with sheet metal flashing secured with noncorrosive roofing nails.
- B. Coordinate installation with flashings and other adjoining work to ensure proper sequencing. Do not install roofing materials until all vent stacks and other penetrations through roof sheathing have been installed and are securely fastened against movement.

3.3 INSTALLATION

- A. General: Comply with manufacturer's instructions and recommendations but not less than those recommended by ARMA's "Residential Asphalt Roofing Manual" or "The NRCA Steep Roofing Manual."
 - 1. Fasten asphalt shingles to roof sheathing with nails.
- B. Underlayment: install in accordance with manufacturer's recommendations and Florida Product Approval installation instructions.

- C. Closed-Cut Valleys: Comply with ARMA and NRCA recommendations.
 - D. Install asphalt shingles, beginning at roof's lower edge, with a starter strip of roll roofing or inverted asphalt shingles with tabs removed. Fasten asphalt shingles in the desired weather exposure pattern; use 6 hot-dipped galvanized roofing nails per shingle. Use vertical and horizontal chalk lines to ensure straight coursing.
 - 1. Cut and fit asphalt shingles at valleys, ridges, and edges to provide maximum weather protection. Provide same weather exposure at ridges as specified for roof. Lap asphalt shingles at ridges to shed water away from direction of prevailing wind.
 - 2. Use fasteners at ridges of sufficient length to penetrate sheathing as specified.
 - E. Comply with installation details and recommendations of shingle manufacturer and NRCA Steep Roofing Manual.
 - 1. Comply with manufacturer's recommendations for installation of shingles in "high wind area".
 - F. Flashing: Install metal flashing and vent flashing as indicated and in compliance with details and recommendations of the NRCA Steep Roofing Manual.
- 3.4 ADJUSTING
- A. Replace any damaged materials installed under this Section with new materials that meet specified requirements.

END OF SECTION

SECTION 07 4110 - METAL ROOF PANELS (ALTERNATE)

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Standing-seam metal roof panels installed on plywood decks.
 - 2. Metal roofing installed on cupola roofs.
 - 3. Installer-fabricated fascia trim.
 - 4. Preformed soffit panels with "v-groove" profile and concealed fasteners.
 - 5. Installer-fabricated gutters and downspouts
 - 6. Concealed fastenings, flashings, edge metal, trim, cleats, sealants, filler, etc. required for a complete, weathertight installation.
- B. Reglet and counterflashing at roof-wall intersection is specified in Section 07620 - Sheet Metal Flashing and Trim.

1.3 DEFINITIONS

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight roofing system.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Design metal roof panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at the following test-pressure difference:
 - 1. Test-Pressure Difference: Positive and negative 1.57 lbf/sq. ft.
 - 2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
 - 3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift pressure difference.
- D. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
 - 1. Test-Pressure Difference: No water penetration at 20 lbf/sq.ft.
 - 2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
 - 3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift- pressure difference.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- F. Provide panels that comply with the requirements of the Florida Building Code and which carry Florida Product Approval numbers.
- G. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592.
- H. Wind Loads: Provide roof panel systems including anchorage capable of withstanding wind load design pressures calculated according to the requirements of ASCE 7-98.
 - 1. Design wind velocity: refer to structural drawings.
 - 2. Importance factor = 1.15.
 - 3. Maximum allowable panel deflection = 1/180.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- J. Energy Performance: Provide roof panels with solar reflectance index not less than 29 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated, include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of roof panel and accessory.

- B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and end lap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
 - 1. Accessories: Include details of the following items, at a scale of not less than 1- 1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts
- C. Samples for Initial Selection: For each type of metal roof panel indicated with factory- applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Metal Roof Panels: 12 inches long by actual panel width. Include fasteners, clips, closures, and other metal roof panel accessories.
 - 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 - 3. Accessories: 12-inch- long Samples for each type of accessory.
- E. Delegated-Design Submittal: For metal roof panel assembly indicated to comply with performance requirements and design criteria, including analysis data with exact clip spacing and anchorage signed and sealed by the qualified Florida professional engineer responsible for their preparation.
- F. Qualification Data: For qualified Installer.
- G. State of Florida Product Approval number.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- I. Field quality-control reports.
- J. Maintenance Data: For metal roof panels to include in maintenance manuals.
- K. Warranties: Samples of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
 - 1. Panel installer shall have a minimum of three (3) years experience in the installation of concealed clip architectural standing seam metal roofing and show evidence of successful completion of at least three (3) projects of similar size, scope, and complexity.
 - 2. Must be State of Florida certified roofing/sheet metal contractor.
- B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- C. Source Limitations: Obtain each type of metal roof panels from single source from single manufacturer.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, metal roof panel installer, metal roof panel manufacturer's representative, lightning protection system installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal roof panel and soffit panel installation, including manufacturer's written instructions.
 - 4. Examine deck substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 5. Review structural loading limitations of deck during and after roofing.
 - 6. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 - 7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
 - 8. Review temporary protection requirements for metal roof panel assembly during and after installation.
 - 9. Confirm schedule for roof inspections (minimum of three) to be made by roof panel manufacturer.
 - 10. Review roof observation and repair procedures after metal roof panel installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
- B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal roof panels with rain drainage work, flashing, trim, and construction of decks, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Twenty years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: Twenty years from date of Substantial Completion.
- C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: Twenty years from date of Substantial Completion.
 - 2. Warranted Wind Velocity: 130mph (3 second peak gust per Florida Building Code) with no exemptions or exclusions. Wind velocity, or loads noted in 1.4 - Performance Requirements, shall be noted in writing on the warranty document.

PART 2 - PRODUCTS

2.1 ROOF PANEL MATERIALS

- A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - 1. Surface: Smooth, flat finish.
- B. Panel Sealants:
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.2 ROOF UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: 40 mils thick minimum, consisting of slip-resisting, polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 - 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
 - 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc., Div. of Carlisle Companies Inc.; CCW WIP 300HT.
 - b. Grace Construction Products; a unit of Grace, W. R. & Co.; Ultra.
 - c. Henry Company; Blueskin PE200 HT.

4. Metal-Fab Manufacturing, LLC; MetShield.
 - a. Owens Corning; WeatherLock Metal High Temperature Underlayment.

2.3 MISCELLANEOUS MATERIALS

- A. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15- mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 1. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 330 and E 331.
- B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together.
 1. Subject to compliance with requirements, provide one of the following:
 - a. "Stand 'N Seam Metal Roofing", Fabral.
 - b. "Zip-Rib Standing Seam Panel", Merchant & Evans, Inc.
 - c. "Tite-Loc Plus", Petersen Aluminum Corporation.
 2. Material: Aluminum sheet, 0.040-inch thick.
 - a. Exterior Finish: Metallic fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 3. Joint Type: As standard with manufacturer.
 4. Panel Coverage: 12 inches.
 5. Panel Height: 2 - 2.5 inches.

2.5 ACCESSORIES

- A. Roof Panel Accessories: Provide components approved by roof panel manufacturer and as required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
 2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin- foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible.
 - a. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- B. Flashing and Trim: Formed from same material as roof panels, prepainted with coil coating, minimum .040 inch thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

2.6 SOFFIT PANELS

- A. Manufacturer: Subject to compliance with requirements, provide soffit panels as follows:
 1. Aluminum V-Groove Soffit Panels: Double 6", solid, v-groove soffit, nominal 3/8" deep, prefinished, 0.019". Provide "Envoy Aluminum Soffit by Alcoa Home Exteriors in any standard color as selected by Architect.
 - a. Provide 0.019" J-channel in matching color.

2.7 FABRICATION, GENERAL

- A. Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal roof panel side laps with a bead of elastomeric sealant that provides a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within panel assembly.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
4. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

2.8 GUTTER, FASCIA, AND DOWNSPOUT FABRICATION

- A. General: Fabricate fascia, gutters and downspouts to profiles indicated on drawings. Shop-fabricate work to greatest extent possible. Comply with details shown and with requirements of SMACNA "Architectural Sheet Metal Manual".
- B. Material: Aluminum sheet with "Kynar 500" fluoropolymer coating in thicknesses as follows:
 1. Fascia: .040 Inch.
 2. Gutters: .050 inch, with .063 inch uncoated hangers.
 3. Downspouts: .040 Inch.
- C. Hanging Gutter: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter straps spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant.
 1. Fabricate gutters for watertight performance.
 2. Fasten gutter hangers to front and back of gutter.
 3. Loosely lock straps to front gutter bead and anchor to roof deck.
 4. Install gutter with expansion joints not exceeding 50 feet apart. Install expansion- joint caps.
- D. Downspouts: Downspouts shall be continuous without joints.
 1. Provide hangers of same material as downspouts with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at maximum of 48 inches o.c. in between.

2.9 METAL FINISHES

- A. Fluoropolymer Coating: Manufacturer's standard two-coat; thermo-cured, full-strength 70 percent "Kynar 500" coating with suspended mica flakes consisting of a primer and a minimum 0.75-mil dry film thickness top coat with a total minimum dry film thickness of 0.9-mil and minimum 30 percent reflective gloss when tested in accordance with ASTM 0523.
 1. Durability: Provide coating that has been field tested under normal range of weathering conditions for minimum of 20 years without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of a chalk rating of 8 in accordance with ASTM 04214; and without fading in excess of 5 Hunter units.
 2. Color: As selected by the architect from the manufacturer's full range of colors.
 3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5-mil.
- B. High Performance Organic Coating (Soffits Only).
 1. For aluminum v-groove soffit panels, provide manufacturer's standard finish, Alumalure 2000 by Alcoa, or equal.

2.10 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets, self-locking bolts, end- welded studs and other suitable fasteners designed to withstand design loads.
- B. Accessories: Provide components required for a complete fascia and soffit panel system, including trim, copings, sills, corner units, flashings, sealants, gaskets, fillers, and similar items. Match materials and finishes of panels.
 1. Sealing Tape: Pressure sensitive 100 percent solids polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
 2. Join Sealant: One-part elastomeric polyurethane, polysulfide, or silicone rubber sealant as recommended by the panel manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.
- B. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

- C. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- D. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
 - 1. Entirety of roof area.

3.3 METAL ROOF PANEL INSTALLATION, GENERAL

- A. Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
- B. Thermal Movement. Rigidly fasten metal roof panels to structure at one and only one location for each panel. Allow remainder of panel to move freely for thermal expansion and contraction. Predrill panels for fasteners.
 - 1. Point of Fixity: Fasten each panel along a single line of fixing located at ridge.
 - 2. Avoid attaching accessories through roof panels in a manner that will inhibit thermal movement.
- C. Install metal roof panels as follows:
 - 1. Commence panel installation and complete at least 10% but no more than 20% of the installation for initial inspection by a facility-authorized representative of the panel manufacturer.
 - 2. Field cutting of metal panels by torch is not permitted.
 - 3. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 4. Provide metal closures at rake edges rake walls and each side of ridge and hip caps.
 - 5. Flash and seal metal roof panels with weather closures at eaves, rakes, and
 - 6. perimeter of all openings.
 - 7. Install ridge and hip caps as metal roof panel work proceeds.
 - 8. End Splices: Not allowed.
 - 9. Install metal flashing to allow moisture to run over and off metal roof panels.
- D. Fasteners:
 - 1. Aluminum Roof Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- E. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- F. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
 - 1. Coat back side of roof panels with bituminous coating where roof panels will contact wood, ferrous metal, or cementitious construction.
- G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.
 - 1. Prepare joints and apply sealants to comply with panel manufacturer's requirements.

3.4 METAL ROOF PANEL INSTALLATION

- A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
 - 1. Install clips to roof sheathing with wood screws.
 - 2. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

3.5 FASCIA AND SOFFIT PANEL INSTALLATION

- A. Comply with manufacturer's instructions for assembly and installation. Install in accordance with approved shop drawings.
 - 1. Install v-groove aluminum soffit panels as indicated on drawings and in accordance with manufacturer's requirements for State of Florida product approval.
- B. Isolate dissimilar metals and masonry or concrete from metals with bituminous coating. Use gasketed fasteners where required to prevent corrosive action between fastener, substrate, and panels.
- C. Limit exposed fasteners to extent indicated on shop drawings.

- D. Anchorage shall allow for temperature expansion/contraction movement without stress or elongation of panels or anchors.
- E. Coordinate flashing and sheet metal work to provide weathertight conditions at roof terminations. Fabricate and install in accordance with SMACNA standards, using continuous cleats where indicated on drawings.
- F. Installed fascia and soffit system shall be true to line and plane and free of dents and physical defects with a minimum of oil canning.
- G. Form joints in linear metal to allow for 1/4" inch minimum expansion at 20'-0" o.c. maximum and 8'-0" from corners. Provide 6 inch wide back-up plate at intersections. Form plates to profile of sheet metal item.

3.6 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and Level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Connect downspouts to underground drainage system indicated.
- E. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.
- G. Drip edges shall be 3/4" min. from fascia.

3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof panel installation, including accessories at least twice during installation. Report results in writing, with photographs of installation progress.
- B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation
- B. Instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- C. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 4646 - FIBER-CEMENT SIDING

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Fiber-cement siding.
- 1.2 RELATED REQUIREMENTS
 - A. Section 07 2500 - Weather Barriers: Water-resistive barrier under siding.
 - B. Section 07 9005 - JOINT SEALERS.
 - C. Section 09912 - Painting
- 1.3 REFERENCE STANDARDS
 - A. ASTM C1186 - Standard Specification for Flat Fiber Cement Sheets.
- 1.4 SUBMITTALS
 - A. See Section 01 3000 - Administrative Requirements for submittal procedures.
 - B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Manufacturer's requirements for related materials to be installed by others.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods, including nail patterns.
 - C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.
 - D. Manufacturer's qualification statement.
 - E. Installer's qualification statement.
 - F. Maintenance Instructions: Periodic inspection recommendations and maintenance procedures.
 - G. Warranty: Submit copy of manufacturer's warranty, made out in Hillsborough County's name, showing that it has been registered with manufacturer.
- 1.5 QUALITY ASSURANCE
 - A. Installer Qualifications: Company specializing in performing work of type specified in this section with not less than three years of experience.
 - B. Mock Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with the remaining work until workmanship, color, and sheen, are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.
 - B. Deliver and store materials in manufacturer's unopened packaging, with labels intact, until ready for installation.
 - C. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.
 - D. Protect materials from harmful environmental elements, construction dust, and other potentially detrimental conditions.
- 1.7 FIELD CONDITIONS
 - A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.
- 1.8 WARRANTY
 - A. Product Warranty: 30-year limited product warranty against manufacturing defects.
 - B. Workmanship Warranty: Application limited warranty for 2 years.

PART 2 PRODUCTS

- 2.1 FIBER-CEMENT SIDING
 - A. Lap Siding: Individual horizontal boards made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Style: Standard lap style.
 - 2. Texture: Smooth.
 - 3. Length: 12 feet, nominal.
 - 4. Width (Height): 5-1/4 inches.
 - 5. Thickness: 5/16 inch, nominal.
 - 6. Finish: Unfinished.

- 7. Warranty: 30 year limited; transferable.
- 8. Products:
 - a. Allura, a division of Plycem USA, Inc: www.allurausa.com/#sle.
 - b. CertainTeed Corporation : www.certainteed.com.
 - c. James Hardie Building Products, Inc: www.jameshardie.com/#sle.
 - d. Nichiha USA, Inc: www.nichiha.com/#sle.

2.2 ACCESSORIES

- A. Furring Strips, Metal: Galvanized metal channels.
- B. Trim: Same material and texture as siding.
- C. Fasteners: Galvanized or corrosion resistant; length as required to penetrate, 1-1/4 inches, minimum.
- D. Sealant: Elastomeric, polyurethane or silyl-terminated polyether/polyurethane, and capable of being painted.
- E. Joint Sealer: As specified in Section 07 9005.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.
- B. Do not begin until unacceptable conditions have been corrected.
- C. If substrate preparation is responsibility of another installer, notify Wilder Architecture, Inc. of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Protect surrounding areas and adjacent surfaces during execution of this work.
- B. Install Sheet Metal Flashing:
 - 1. Above door and window trim and casings.
 - 2. Above horizontal trim in field of siding.

3.3 INSTALLATION

- A. Install siding in accordance with manufacturer's instructions and recommendations.
 - 1. Read warranty and comply with terms necessary to maintain warranty coverage.
 - 2. Use trim details as indicated on drawings.
 - 3. Touch up field cut edges before installing.
 - 4. Pre-drill nail holes if necessary to prevent breakage.
- B. Over Masonry Walls: Install furring strips of adequate thickness to accept full length of nails and spaced at 16 inches on center; leave space at top and bottom open; top may be behind soffit; at bottom install insect screen over opening by wrapping a strip of screen over bottom ends of vertical furring strips.
- C. Allow space for thermal movement between both ends of siding panels that butt against trim; seal joint between panel and trim with specified sealant.
- D. Joints in Horizontal Siding: Avoid joints in lap siding except at corners; where joints are inevitable stagger joints between successive courses.
- E. Do not install siding less than 6 inches from ground surface, or closer than 1 inch to roofs, patios, porches, and other surfaces where water may collect.
- F. After installation, seal joints except lap joints of lap siding; seal around penetrations, and paint exposed cut edges.
- G. Finish Painting: Specified in Section 09 9120 - Painting

3.4 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 5400 - THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Mechanically attached system with thermoplastic roofing membrane.
 - B. Insulation, flat and tapered.
 - C. Deck sheathing.
 - D. Flashings.
 - E. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.
- 1.2 RELATED REQUIREMENTS
 - A. Section 05310 - Metal Deck.
- 1.3 REFERENCE STANDARDS
 - A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - B. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing.
 - C. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
 - D. FM DS 1-28 - Wind Design.
 - E. NRCA (RM) - The NRCA Roofing Manual.
 - F. NRCA (WM) - The NRCA Waterproofing Manual.
- 1.4 SUBMITTALS
 - A. See Section 01 3000 - Administrative Requirements for submittal procedures.
 - B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, surfacing, and fasteners.
 - 1. LEED Submittal: Include testing documentation of solar reflectance index.
 - C. Product Approval Conformance: Review the corresponding Product Approval Sheet (PA Series) in the drawing set. Incorporate the requirements described therein with the product submittal.
 - 1. Include the current Florida Product Approval documentation, including installation instructions, with the submittal.
 - D. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
 - E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
 - F. Certificates: Provide current Florida Product Approval, including installation instructions.
 - G. Manufacturer's qualification statement.
 - H. Installer's qualification statement.
 - I. Warranty Documentation:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Hillsborough County's name and registered with manufacturer.
 - 2. Submit installer's written verification that installation complies with warranty conditions for waterproof membrane.
 - J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Hillsborough County's name and registered with manufacturer.
- 1.5 QUALITY ASSURANCE
 - A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
 - B. Installer Qualifications: Company specializing in performing work of this section with at least three years of documented experience.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, unless otherwise indicated.
 - B. Store materials in weather protected environment, clear of ground and moisture.
 - C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
 - D. Protect foam insulation from direct exposure to sunlight.
- 1.7 WARRANTY
 - A. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
 - 1. Warranty Term: 20 years.

- a. No Dollar Limit.
- 2. For repair and replacement include costs of both material and labor in warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:
 - 1. Carlisle SynTec Systems; Sure-Weld TPO: www.carlisle-syntec.com/#sle.
 - 2. GAF; EverGuard TPO 60 mil: www.gaf.com/#sle.
 - 3. GenFlex Roofing Systems, LLC: www.genflex.com/#sle.
 - 4. Johns Manville; JM TPO - 45 mil: www.jm.com/#sle.
- B. Insulation:
 - 1. DuPont de Nemours, Inc: building.dupont.com/#sle.
 - 2. GAF: www.gaf.com/#sle.

2.2 ROOFING

- A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation.
 - 1. 60 Mil minimum.
- B. Roofing Assembly Requirements:
 - 1. Solar Reflectance Index (SRI): 78, minimum, calculated in accordance with ASTM E1980.
 - a. Field applied coating may not be used to achieve specified SRI.
- C. Acceptable Insulation Types - Constant Thickness Application:
 - 1. Single layer of polyisocyanurate board.
- D. Acceptable Insulation Types - Tapered Application:
 - 1. Tapered polyisocyanurate board.

2.3 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

- A. Membrane Roofing Materials:
 - 1. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrims.
 - a. Thickness: 60 mil, 0.060 inch, minimum.
 - 2. Solar Refelctance: 79% per ASTM E903.
 - 3. Color: White.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Membrane Fasteners: As recommended and approved by membrane manufacturer.
 - 1. Reference approved fasteners on Miami Dade NOA on the Product Approval Sheet.
- D. Flexible Flashing Material: Same material as membrane.

2.4 INSULATION

- A. Reference approved insulation products on Florida Product Approval Sheet.
- B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - 1. Classifications:
 - a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
 - 1) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.
 - 2) Compressive Strength: Classes 1-2-3, Grade 1, 16 psi (110 kPa), minimum.
 - 3) Thermal Resistance, R-value: At 1-1/2 inches thick; Class 1, Grades 1-2-3, 8.4 (1.48), minimum, at 75 degrees F.
 - 2. Board Size: 48 by 96 inches.
 - 3. Board Thickness: 1.5 inches.
- C. Glass-mat Gypsum Core Board: Dens-Deck.
 - 1. Board Size" 48 x 96 inch.
 - 2. Board Thickness: 1/2".
 - 3. Thermal Resistance: R-value of 0.5.
 - 4. Manufacturer:
 - a. G-P Gypsum.
 - b. Substitutions: See Section 01600 - Product Requirements.

2.5 ACCESSORIES

- A. Cant and Edge Strips: Wood fiberboard, compatible with roofing materials; cants formed to 45 degree angle.
- B. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

- C. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
 - 1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
- D. Membrane Adhesive: As recommended by membrane manufacturer.
- E. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
- F. Roofing Nails: Galvanized, hot-dipped type, size and configuration as required to suit application.
- G. Strip Reglet Devices: Stainless steel, Type 304 - 0.020", maximum possible lengths per location, with attachment flanges.
 - 1. Basis of Design: Fry Reglet "STX", or equal.
- H. Sealants: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and reglets are in place.

3.2 PREPARATION - WOOD DECK

- A. Verify flatness and tightness of joints in wood decking; fill knot holes with latex filler.
- B. Confirm dry deck by moisture meter with 12 percent moisture maximum.

3.3 INSTALLATION, GENERAL

- A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
- B. Do not apply roofing membrane during cold or wet weather conditions.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.4 INSTALLATION - INSULATION, UNDER MEMBRANE

- A. Attachment of Insulation:
 - 1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions and FM DS 1-28 Factory Mutual requirements.
- B. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.
- C. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- D. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- E. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
- F. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.
- G. Do not install more insulation than can be covered with membrane in same day.

3.5 INSTALLATION - MEMBRANE

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive to substrate at rate of ____ gallons per square foot. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Spot Adhered Application: Mechanically fasten adhesion discs to substrate. Install adhesive to discs and bond membrane. Fully adhere one roll before proceeding to adjacent rolls.
- E. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- F. At intersections with vertical surfaces:
 - 1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
 - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
 - 3. Secure flashing to nailing strips at 4 inches on center.
 - 4. Insert flashing into reglets and secure.
- G. Around roof penetrations, seal flanges and flashings with flexible flashing.

3.6 CLEANING

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
- B. Remove bituminous markings from finished surfaces.
- C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- D. Repair or replace defaced or damaged finishes caused by work of this section.

3.7 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Extent of flashings is indicated on the drawings.
- B. Type of work specified in this Section includes the following:
 - 1. Metal flashing for metal roof panel installation:
 - a. Reglet and counterflashings at intersections of roof and masonry walls.
- C. Metal roof panels, edge metal, fascia, soffits, gutters, and downspouts are specified in Section 07411 "Metal Roof Panels",

1.3 JOB CONDITIONS

- A. Do not proceed with the installation of flashing and sheet metal work until curb and substrate construction, cant strips, blocking and other construction to receive work is completed.
- B. The Installer must examine the substrate and the conditions under which flashing and sheet metal work is to be performed, and notify the Contractor, in writing, of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Fasteners: Aluminum or Series 300 stainless steel.
- C. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

2.2 REGLET AND COUNTERFLASHING SYSTEM

- A. General: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces and compatible with flashing indicated. Provide manufacturer's standard accessories including prefabricated corners, wind clips, and foam end pieces.
- B. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
 - 1. Provide wind-restraint clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following in minimum .025" aluminum:
 - 1. Fry Reglet Corporation; "STX Reglet."
 - 2. Hickman: W.P. Hickman Co.
 - 3. Keystone Flashing Company.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with manufacturer's instructions and recommendations for handling and installation of flashing.
- B. Performance: Coordinate the work with other work for the correct sequencing of items which make up the entire system of weatherproofing or waterproofing and rain drainage. It is required that the flashing be permanently watertight, and not deteriorate in excess of manufacturer's published limitations.

3.2 INSTALLATION OF METAL WORK

- A. Provide for thermal expansion of all exposed flashings as follows:
 - 1. 10'-0" maximum spacing and located 2'-0" from corners and intersections.
- B. Isolate dissimilar metals such as galvanized steel and aluminum by application of bituminous coating to prevent metal to metal contact.

3.3 FLASHINGS AT ROOF-TO-WALL INTERSECTIONS

- A. A Install manufactured reglets to receive counterflashing according to manufacturer's instructions, parallel to roof slope and true to line.

- B. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 6 inches and bed with sealant.

END OF SECTION

SECTION 07 8410 - FIRESTOP SYSTEMS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes fire stopping and smoke sealing for the following:
 - 1. At the head of fire-resistance-rated and smoke-resistant walls abutting the underside of structural floor and roof decks, and the perimeter of such walls at abutting construction.
 - 2. Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
 - 3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.
 - 4. Sealant joints in fire-resistance-rated construction.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 15 Sections "Mechanical."
 - 2. Division 16 Sections "Electrical."

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.
 - 1. Firestopping and smoke sealing shall comply with the requirements of the Florida Building Code, 2004 edition, and NFPA 101, latest edition.
- B. F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.
- C. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per ASTM E 119, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.
- D. For firestopping exposed to moisture and physical damage, provide products that do not deteriorate when exposed to these conditions.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For penetrations involving insulated piping, provide through penetration firestop systems not requiring removal of insulation.

1.4 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
 - 1. Certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.
- C. Shop drawings detailing condition-specific materials, installation methods, and relationships to adjoining construction for each through-penetration firestop and smoke seal system, and each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.
 - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop and smoke seal configuration for construction and penetrating items.
 - 2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration approved by firestopping manufacturer's fire protection engineer with modifications marked.
- D. Product certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.
- E. Product test reports from, and based on tests performed by, a qualified testing and inspecting agency evidencing compliance of firestopping with requirements based on comprehensive testing of current products.
- F. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the "System Performance Requirements" article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per ASTM E 814 under conditions where positive furnace pressure differential of at least 0.01 inch of water is maintained at a distance of 0.78 inch below the fill materials surrounding the penetrating items in the test assembly. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in their "Fire Resistance Directory," by Wamack Hersey, or by another qualified testing and inspecting agency.
 - 3. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E 119 under conditions where the positive furnace pressure differential is at least 0.01 inch of water, as measured 0.78 inch from the face exposed to furnace fire. Provide systems complying with the following requirements:
 - a. Fire-Resistance Ratings of Joint Sealants: As indicated by reference to design designations listed by UL in their "Fire Resistance Directory" or by another qualified testing and inspecting agency.
 - b. Joint sealants, including backing materials, bear classification marking of qualified testing and inspection agency.
- B. Installer Qualifications: Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff, and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- C. Single-Source Responsibility: Obtain through-penetration firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.
- D. Provide firestopping products: shall not contain asbestos. Products shall be certified by manufacturer as "asbestos free."

1.6 COORDINATION

- A. Coordinate with plumbing, mechanical, electrical, and other trades to ensure that pipe, conduit, cable, and other items which penetrate fire-rated or smoke barrier construction have been permanently installed, and sleeved when necessary, prior to installation of firestops and smoke seals.
- B. Schedule and sequence the work to assure that partitions and other construction which would conceal or enclose penetrations are not erected prior to the installation of firestops and smoke seals.

1.7 WARRANTY AND CERTIFICATION

- A. Contractor shall provide the following notarized affidavit jointly signed by corporate officers, with titles noted, of both the Contractor and material applicator:
 - 1. "We the undersigned certify that firestops and smoke seals have been installed in accordance with Contract Document requirements and manufacturer's instructions, and that materials used meet firestopping and smoke sealing requirements of the Contract Documents".
- B. Manufacturer shall provide the following certification, executed by the appropriate person, with title and department noted:
 - 1. "Products provided by (manufacturer) for the (name of project) are composed of the same ingredients and formulation or are of the same components and identical construction as products that have been tested by (the testing agency) for various fire resistive and other performance ratings, and when properly applied or installed in accordance with (manufacturer) instructions will perform in a manner consistent with results obtained in the tests conducted by (the testing agency)".

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver firestopping 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 multicomponent materials.
- B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
- B. Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with "System Performance Requirements" article in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:
 - 1. Permanent forming/damming/backing materials including the following:
 - a. Semirefractory fiber (mineral wool) insulation.
 - b. Ceramic fiber.
 - c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - d. Fire-rated formboard.
 - e. Joint fillers for joint sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.
- C. Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

2.2 FILL MATERIALS FOR THROUGH-PENETRATION FIRESTOP SYSTEMS

- A. Endothermic, Latex Compound Sealant: Single-component, endothermic, latex formulation.
- B. Intumescent, Latex Sealant: Single-component, intumescent, latex formulation.
- C. Intumescent Putty: Nonhardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.
- D. Intumescent Wrap Strips: Single-component, elastomeric sheet with aluminum foil on one side.
- E. Job-Mixed Vinyl Compound: Prepackaged vinyl-based powder product for mixing with water at Project site to produce a paintable compound, passing ASTM E 136, with flame- spread and smoke-developed ratings of zero per ASTM E 84.
- F. Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogenous mortar.
- G. Pillows/Bags: Re-usable, heat-expanding pillows/bags composed of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire- retardant additives.
- H. Silicone Foam: Two-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, nonshrinking foam.
- I. Silicone Sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant of grade indicated below:
 - 1. Grade: Nonsag formulation for openings in vertical and other surfaces requiring a nonslumping/ gunnable sealant.
- J. Acoustical Sealant (for use only in assemblies indicated to be smoke resistant; not for firesafing of assemblies with fire resistance ratings): ASTM C919 and ASTM C834, water- based, highly elastic caulking; non-bleeding and staining, permanently flexible. Flame spread 0, smoke developed 0.
- K. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Endothermic, Latex Sealant:
 - a. Fyre-Shield, Tremco Inc.
 - 2. Endothermic, Latex Compounds:
 - a. Flame-Safe FS500/600 Series, W.R. Grace.
 - b. Flame-Safe FS900/FST900 Series, W.R. Grace.
 - 3. Intumescent Latex Sealant:
 - a. Metacaulk 1000, The RectorSeal Corporation.
 - b. Fire Barrier CP 25WB Caulk, 3M Fire Protection Products.
 - c. Bio Fireshield 500+, The RectorSeal Corporation.
 - d. Bio Fireshield Bio-BF150, The RectorSeal Corporation.
 - 4. Intumescent Putty:
 - a. Pensil 500 Intumescent Putty, General Electric Co.
 - b. SpecSeal Series SSP, Specified Technologies, Inc.
 - c. Fire Barrier Moldable Putty, 3M Fire Protection Products.
 - d. Bio Fireshield Fire Rated Putty, The RectorSeal Corporation.

5. Intumescent Wrap Strips:
 - a. Fire Barrier FS-195 Wrap/Strip, 3M Fire Protection Products.
 - b. Bio Fireshield Wrap Strip, The RectorSeal Corporation.
6. Job-Mixed Vinyl Compound:
 - a. USG Firecode Compound, United States Gypsum Co.
7. Mortar:
 - a. Bio Fireshield K-2 Firestop Mortar, The RectorSeal Corporation
 - b. Bio Fireshield K-10 Firestop Mortar, The RectorSeal Corporation
 - c. KBS-Mortar Seal, International Protective Coatings Corp.
8. Pillows/Bags:
 - a. Bio Fireshield Firestop Pillows, The RectorSeal Corporation
 - b. KBS Sealbags, International Protective Coatings Corp.
9. Silicone Foams:
 - a. Pensil200 Foam, General Electric Co.
10. Silicone Sealants:
 - a. Pensil 100 Firestop Sealant, General Electric Co.
 - b. Metacaulk 835+, The RectorSeal Corporation.
 - c. Fyre-Sil, Tremco Inc.
 - d. Fyre-Sil S/L, Tremco Inc.
 - e. Bio Fireshield Biotherm 100 & 200, The RectorSeal Corporation
11. Acoustical Sealant
 - a. Sheetrock Acoustical Sealant, U.S. Gypsum Company.
 - b. PL Acoustical Sealant; ChemRex, Inc.; Contech Brands.
 - c. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.

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 of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
 1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
 2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form release agents from concrete.
- B. Priming: Prime substrates where recommended by firestopping 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 firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.3 INSTALLING FIRESTOPS AND SMOKESEALS

- A. General: Comply with the "System Performance Requirements" article in Part 1 and the firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration and head-of-wall firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
 1. In non-fire-rated, smoke-resistant assemblies, install resilient sealant, either acoustical or fire-resistant type, to completely fill all voids at through-penetrations and head-of-wall intersections to block the passage of smoke. In no event shall drywall compound be used for this purpose.
- C. Install fill materials for through-penetration and head-of-wall firestop systems by proven techniques to produce the following results:
 1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 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 INSTALLING FIRE-RESISTIVE JOINT SEALANTS

- A. General: Comply with the "System Performance Requirements" article in Part 1, with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.
- C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.
 1. Tool nonsag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces
 2. adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.5 CLEANING

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.
- B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

END OF SECTION

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes joint sealants for the following locations:
 - 1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:
 - a. Control and expansion joints in unit masonry.
 - b. Control and expansion joints in Portland cement plaster.
 - c. Perimeter joints between materials listed above and frames of doors and windows.
 - d. Control and expansion joints in ceiling and overhead surfaces.
 - e. Other joints as indicated.
 - f. Exterior joints in horizontal traffic surfaces as indicated below:
 - g. Control, expansion, and isolation joints in cast-in-place concrete slabs.
 - h. Other joints as indicated.
 - 2. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - 3. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
 - a. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - b. Other joints as indicated.
 - 4. Interior joints in horizontal traffic surfaces as indicated below:
 - a. Control and expansion joints in cast-in-place concrete slabs.
 - b. Other joints as indicated.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 7 Section "Flashing and Sheetmetal" for sealants used in sheetmetal work.
 - 2. Division 8 Section "Glass and Glazing" for sealants used in glazing.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract.
- B. Product data from manufacturers for each joint sealant product required.
- C. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.
- D. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.
- E. Provide and maintain a file of manufacturer's instructions for each of the products used.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.
- B. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
 - 2. When joint substrates are wet.

- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.8 SEQUENCING AND SCHEDULING

- A. Sequence installation of joint sealants in existing interior concrete pavement to occur prior to application of clear concrete sealing compound where indicated or scheduled on drawings.

1.9 WARRANTY

- A. Provide a five (5) year manufacturer and installer warranty for joint sealants provided on the project.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors: Provide color of exposed joint sealants to comply with the following:
 - 1. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

2.2 ELASTOMERIC JOINT SEALANTS

- A. A Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920; including those requirements referencing ASTM C 920 classifications for Type, Grade, Class, and Uses.
- B. Products: Subject to compliance with requirements, provide one of the products specified.
- C. Single Part Pourable Urethane Sealant for use in horizontal joints in floor slabs, sidewalks, and concrete pavement. Provide one of the following:
 - 1. "Vulkem 45"; Mameco International, Inc.
 - 2. "NR-201 Urexpam"; Pecora Corp.
 - 3. "Sonolastic SL1"; Sonneborn brand by BASF Building Systems.
- D. Single Part Nonsag Urethane Sealant for use in sealing hollow metal door frames to adjoining wall surfaces, roof flashing and edge metal installations, and general purpose exterior sealing except where silicone is specified:
 - 1. "Vulkem 921n"; Tremco.
 - 2. "Dynatrol 1"; Pecora Corp.
 - 3. "Sika Flex-1a"; Sika Corp.
 - 4. "Sonolastic NP 1"; Sonneborn brand by BASF Building Systems.
- E. Medium-Modulus Neutral-Curing Silicone Sealant for use in all exterior masonry control and expansion joints, and for perimeter sealing of aluminum windows and storefronts.
 - 1. 791; Dow Corning (accommodates joint movement of ± 50 percent).
 - a. Apply to masonry and concrete with Dow Corning 1200 Primer.
 - 2. "Sonolastic 150"; Sonneborn brand by BASF Building Systems.

2.3 LATEX JOINT SEALANTS

- A. Acrylic-Emulsion Sealant: Manufacturer's standard, one part, nonsag, mildew-resistant, acrylic-emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior locations involving joint movement of not more than plus or minus 5 percent. Provide at intersections of interior door and window frames and adjoining wall surfaces.
 - 1. "AC-20"; Pecora Corp.
 - 2. "Sonolac"; Sonneborn Building Products.

2.4 ACOUSTICAL JOINT SEALANT

- A. Acoustical sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:
 - 1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 2. Install at perimeter joints around all electrical boxes in acoustically-rated walls and all drywall ceilings and elsewhere as indicated on drawings.
- B. Manufacturer - Provide one of the following:
 - 1. AC-20FTR Acoustical and Insulation Sealant; Pecora Corporation
 - 2. Sheetrock Acoustical Sealant; USG Corp.

2.5 MILDEW - RESISTANT SILICONE SEALANT

- A. One-part mildew-resistant interior sealant designed to seal nonporous interior building surfaces including tubs, sinks, lavatories, and urinals at perimeter intersection with finished walls.
- B. Manufacturer - Provide one of the following:
 - 1. Dow Corning 786 Mildew-Resistant Silicone Sealant.
 - 2. Sanitary SCS1700 Sealant; G.E. Silicones

2.6 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of either material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, non-outgassing in unruptured state.
 - 2. Proprietary, reticulated, closed-cell polymeric foam, non-outgassing, with a density of
 - 3. pcf (40 kg/cu. m) and tensile strength of 35 psi (240 kPa) per ASTM D 1623, and with water absorption less than 0.02 g/ft² per ASTM C 1083.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
 - 3. Remove laitance and form release agents from concrete.
 - 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
 - 1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - a. Do not leave gaps between ends of joint fillers.
 - b. Do not stretch, twist, puncture, or tear joint fillers.
 - c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.
 - 2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.
- D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 - 1. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 08 1110 - STANDARD STEEL DOOR AND FRAMES

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Standard hollow-metal steel doors.
 - 2. Standard hollow-metal steel frames.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 4 Section "Unit Masonry" for building anchors into and grouting frames in masonry construction.
 - 2. Division 8 Section "Flush Wood Doors" for solid-core wood doors installed in steel frames.
 - 3. Division 8 Section "Door Hardware" for door hardware and weatherstripping.
 - 4. Division 8 Section "Glazing" for glass in steel doors and sidelights.
 - 5. Division 9 Section "Painting" for field painting primed doors and frames.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.

1.4 SUBMITTALS

- A. Approval Numbers: Provide State of Florida Product Approval Numbers.
- B. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of steel door and frame specified.
- C. Shop Drawings:
 - 1. In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:
 - a. Elevations of each door design
 - b. Details of doors, including vertical and horizontal edge details.
 - c. Frame details for each frame type, including dimensioned profiles.
 - d. Details and locations of reinforcement and preparations for hardware.
 - e. Details of each different wall opening condition.
 - f. Details of anchorages, accessories, joints, and connections.
 - 2. State of Florida Product Approval must be applicable to actual door and frame sizes indicated on drawings.
 - a. Provide Missile Level 'E' performance for exterior doors and frames.
 - 3. Shop drawings shall indicate hardware locations for doors and frames based upon Steelcraft standards. No other locations are acceptable.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.
 - 1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 108.
- D. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
 - 1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

- A. Coordinate installation of anchorages for standard steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ceco Door Products.
 - 2. CURRIES Company; an ASSA ABLOY Group Company.
 - 3. Republic Builders Products Company.
 - 4. Steelcraft; an Ingersoll-Rand Company.
 - 5. Hollow Metal, Inc.
 - 6. Amweld International, LLC

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.
- D. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.

2.3 STANDARD STEEL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.
 - 1. Design: As indicated on Drawings.
 - 2. Core Construction: Manufacturers standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
 - a. A 1-inch cell honeycomb core shall be laminated to the inside of both face panels with a waterproof adhesive. The honeycomb material shall be 99 lb. test kraft paper and have a crushing strength of not less than 4000 pounds per square foot (psf) and the lamination shall withstand not less than 1100 psf in shear.
 - b. Fire Door Core: As required to provide fire-protection ratings indicated.
 - 3. Vertical Edges for Single-Acting Doors: Beveled edge
 - a. Beveled Edge: 1/8 inch in 2 inches.
 - 4. Top and Bottom Edges: Closed with flush (at top), inverted (at bottom), 0.042-inch-thick end closures or channels of same material as face sheets.
 - 5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior and Interior Doors: Face sheets fabricated from A-60 galvannealed steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for lever and model and ANSI A250.4 for physical-endurance level:
 - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless), 16 gage (.053 inch).
 - 2. Hollow metal steel doors shall be 1-3/4 inches thick heavy-duty, full flush hollow steel, lock seam construction fabricated from 16 gauge prime quality galvanized steel (from A60 or G60 sheet steel) conforming to ASTM A 526 or ASTM A 591.
 - 3. Door face sheets shall be formed from one sheet of metal with no seams permitted on the door face. Seams shall be permitted on the vertical edge of the door only. Top and bottom of door shall be closed with a minimum 16 gauge flush or inverted closure channel.
- C. Hardware Reinforcement: Fabricate reinforcement plates from same material as door face sheets to comply with the following minimum sizes:
 - 1. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
 - 2. Pivots: Minimum 0.167 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.

3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick.
4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.
- D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot- rolled steel sheet.
- E. The clearances for doors shall be 3/32 to 1/8-inch at jambs and heads, and 1/8 to 3/16-inch at meeting stiles of pair of doors. The lock edges of stiles shall be beveled 1/8-inch in 2-inches for steel doors.
- F. The top and bottom edges of all steel doors shall be closed to provide a weather seal. This seal shall be provided as part of the door construction or by the addition of inverted steel channels or other suitable shapes welded, caulked and sealed to the face sheets.
- G. All exterior doors shall receive a shop-applied coat of epoxy over primer.
- H. All exterior doors shall be insulated.

2.4 STANDARD STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
 1. Galvanized sheet steel conforming to ASTM A 526 or ASTM A 591.
 2. Welded type frames (both inside mitered corners and butt edges).
- B. Exterior and Interior Frames: Fabricated from A-60 galvanized steel sheet.
 1. Fabricate frames with mitered or coped and continuously welded face corners.
 2. Frames for Level 3 Steel Doors: 14 gage (.078 inch) thick steel sheet at exterior.
 3. Frames for Level 3 Steel Doors: 16 gage (.064 inch) thick steel sheet at interior.
 4. Stop: 5/8" min.
 5. Head: 4" high in masonry or 2" high in metal stud partitions.
- C. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:
 1. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
 2. Pivots: Minimum 0.167 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
 3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick.
 4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.
- D. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.
- E. Jamb Anchors:
 1. Masonry Type: Adjustable strap-and-stirrup anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long.
 2. Post installed Expansion Type for In-Place Concrete Masonry: minimum 3/8- inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- F. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot- rolled steel sheet.
- G. Plaster Guards: Formed from same material as frames, not less than 0.016-inch thick.
- H. Provide rain drip at exterior door frames.
- I. Strike jambs shall be provided with three (3) holes for field installation of rubber bumpers (silencers) furnished by frame manufacturer.
- J. All exterior frames shall be galvanized and shall be back-coated with a bituminous fibrous layer. Finish shall be smooth, as in a sprayed application. Excessive orange peel, brush or roller marks are not acceptable.
- K. All exterior frames shall receive an epoxy coating over primer at fabricator.

2.5 FABRICATION

- A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Standard Steel Doors:
 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
 3. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete or masonry.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:

- a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. Provide three anchors per jamb.
- b. Post installed Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
- 5. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.
 - 1. All locations shall be based upon Steelcraft standards.
 - 2. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware.
 - 3. Comply with applicable requirements in ANSI A250.6 and ANSI/OHi A115 Series specifications for door and frame preparation for hardware. Locate hardware according to ANSI A250.8.

2.6 STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish standard steel door and frames after assembly.
- B. Galvannealed Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint for reglazing welds in steel, complying with SSPC-Paint 20.
- C. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250. 10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of standard steel doors and frames.
 - 1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines. and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware,

3.3 INSTALLATION

- A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Standard Steel Frames: Install standard steel frames for doors of size and profile indicated. Comply with SDI 105.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.

- b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - c. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - 2. In-Place Concrete or Masonry Construction: Secure frames in place with post installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 3. All exterior frames in masonry construction will be filled solid with concrete grout.
 - 4. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
 - C. Standard Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 3. Smoke-Control Doors: Install doors according to NFPA 105.
- 3.4 ADJUSTING AND CLEANING
- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.
 - B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.
 - C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
 - D. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

- 4.1 ADJUSTING AND CLEANING
- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.
 - B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.
 - 1. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
 - a.
 - 2.
 - 3. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

SECTION 08 2110 - FLUSH WOOD DOORS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Solid core doors with wood veneer faces.
 - 2. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Sections:
 - 1. Division 9 Section "Painting" for field painting of metal louvers and metal frames for light openings.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product data for each type of door, including details of core and edge construction, trim for openings and louvers, and factory-finishing specifications.
- C. Shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, and other pertinent data.
 - 1. For factory-machined doors, indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light and louver openings.
- D. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:
 - 1. Faces of Factory-Finished Doors: Show the full range of colors available for stained finishes.
- E. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

1.4 QUALITY ASSURANCE

- A. Quality Standard: Comply with the following standard:
 - 1. AWI Quality Standard: Architectural Woodwork Quality Standards® of the Architectural Woodwork Institute for grade of door, core, construction, finish, and other requirements.
- B. Fire-Rated Wood Doors: Provide wood doors that comply with NFPA 80; are identical in materials and construction to units tested in door and frame assemblies per ASTM E 152; and are labeled and listed by UL, Warnock Hersey, or another testing and inspection agency acceptable to authorities having jurisdiction.
- C. Single-Source Responsibility: Obtain doors from one source and by a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standard and manufacturer's instructions.
- B. Identify each door with individual opening numbers as designated on shop drawings, using temporary, removable, or concealed markings.

1.6 PROJECT CONDITIONS

- A. Conditioning: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during the remainder of the construction period to comply with the following requirements applicable to Project's geographical location:
 - 1. AWI quality standard Section 100-S-11 "Relative Humidity and Moisture Content."

1.7 WARRANTY

- A. General Warranty: Door manufacturer's warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section or that show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span, or do not conform to tolerance limitations of referenced quality standards.
 - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.
 - 2. Warranty shall be in effect during the following period of time after date of Substantial Completion.
 - a. Solid Core Interior Doors: Ten (10) years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide doors by one of the following:

1. Solid Core Doors:
 - a. Algoma Hardwoods, Inc.
 - b. Eggers Industries
 - c. Graham Wood Doors
 - d. Marshfield Door Systems
 - e. Mohawk Flush Doors, Inc.
 - f. VT Industries, Inc.

2.2 INTERIOR FLUSH WOOD DOORS

A. Solid Core Doors for Transparent Finish: Comply with the following requirements:

1. Faces: Running, book-matched, rotary-cut, white birch.
2. AW.I. Grade: Premium.
3. Construction: PC 5 (Particleboard core, 5 ply, with core bonded to faces).
4. Core: Particleboard core, ANSI A208. 1, Grade LD-2.
5. Bonding: stiles and rails bonded to core, then entire unit abrasive planed before veneering.
6. Doors shall be solid core construction.

B. Fire-Rated Solid Core Doors: Comply with the following requirements:

1. Faces and Grade: Provide faces and grade to match non-fire-rated doors in same area of building, unless otherwise indicated.
2. Construction: Manufacturer's standard core construction as required to provide fire-resistance rating indicated.
3. Blocking: Provide composite blocking designed to maintain fire resistance of door but with improved screw-holding capability of same thickness as core and with minimum dimensions as follows:
 - a. 5-inch top rail blocking.
 - b. 5-inch bottom rail blocking.
 - c. 5-by-18-inch lock blocks.
 - d. 5-inch midrail blocking.

2.3 LOUVERS AND LIGHT FRAMES

A. Metal Louvers:

1. Blade Type: Vision-proof, inverted V.

B. Metal and Finish: Galvanized steel, 0.0396 inch thick, hot-dip zinc coated and factory primed for paint finish.

C. Fire Door Louvers: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire rating of one and one-half hours and less.

D. Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.0478- inch thick, cold-rolled steel sheet; factory primed and approved for use in doors including fire rated doors where indicated.

2.4 FABRICATION

A. Fabricate flush wood doors to comply with following requirements:

1. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels:
 - a. Comply with clearance requirements of referenced quality standard for fitting.
 - b. Comply with requirements of NFPA 80 for fire-resistance-rated doors.
2. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame shop drawings, DHI A 115-W series standards, and hardware templates.
 - a. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory machining.

B. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.

2.5 FACTORY FINISHING

A. General: Comply with AWI's Architectural Woodwork Quality Standards Illustrated" for factory finishing.

B. Finish doors at factory.

C. Transparent Finish:

1. Grade: Premium
2. Finish: AWI System TR-6 catalyzed polyurethane.
3. Staining: As selected by Architect from manufacturer's full range.
4. Sheen: Satin

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine installed door frames prior to hanging door:
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
 - 2. Reject doors with defects.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation see Division 8 Section "Door Hardware."
- B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and referenced quality standard and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames according to requirements of NFPA 80.
 - 2. Fitting Clearances for Non-Fire-Rated Doors: Provide 1/8 inch at jambs and heads, 1/16 inch per leaf at meeting stiles for pairs of doors, and 1/8 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4-inch clearance from bottom of door to top of threshold.
 - 3. Fitting Clearances for Fire-Rated Doors: Comply with NFPA 80.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.3 ADJUSTING AND PROTECTION

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Refinish or replace doors damaged during installation.
- C. Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 08 3610 - SECTIONAL OVERHEAD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes sectional overhead doors, as follows:
 - 1. Steel panel doors.
- B. Related Sections include the following:
 - 1. Division 9, Section "Painting" for field-applied paint finish on exterior sides of doors.

1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of the Contract.
- B. Product data, roughing-in diagrams, and installation instructions for each type and size of overhead door. Include manufacturer's operating instructions and maintenance data.
- C. Shop drawings for special components and installations which are not fully dimensioned or detailed in manufacturer's data including wind bracing for door panels.
 - 1. Drawings must include details for anchorage of door tracks to building to meet wind and impact load requirements. Indicate fastener or weld type, size, and spacing for attachment to masonry walls. Note actual, field-measured rough door opening dimensions.
 - 2. Shop drawings shall be signed and sealed by a Florida registered professional engineer (PE).
 - 3. Shop Drawings shall include State of Florida Product Approval.
 - a. Approval must be applicable to actual door size specified herein.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide each sectional overhead door as a complete unit produced by a single manufacturer, including frames, sections, brackets, guides, tracks, counterbalance mechanisms, hardware, and installation accessories.
- B. Installer: Installation of sectional doors shall be performed by an authorized representative of the manufacturer.
- C. Single-Source Responsibility: Provide doors, tracks, and accessories from one manufacturer. Provide secondary components from source acceptable to manufacturer of primary components.
- D. Pre-Installation Conference: Schedule and convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
- E. Wind Loads: Provide sectional overhead door system including anchorage to building capable of withstanding wind load design pressures as indicated:
 - 1. In the contract documents.
- F. Missile Impact Loads: Provide sectional overhead door system including anchorage to building capable of withstanding large and small missile impact loads in accordance with the Florida Building Code, Sections 1609 and 1626.
 - 1. Missile 'E' required.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements provide one of the following:
 - 1. Overhead Door Corporation - Series 424 Commercial Steel Door.
 - 2. Raynor Garage Doors - Series S24 SteelForm Standard Steel Door.
 - 3. Clopay Building Products - Series 524 Commercial Sectional Door.
 - 4. Substitutions: Equivalent products by other manufacturers will be considered upon receipt of a properly submitted substitution request not less than 10 days prior to bid opening. Such requests must be accompanied by a copy of a shop drawing reflecting State of Florida Product Approval and compliance with wind load pressures as noted above for the specified door size.

2.2 STEEL SECTIONS

- A. Sectional Door Assembly: Steel door assembly with rabbeted meeting rails to form weathertight joints and provide full-width interlocking structural rigidity. Units shall have the following characteristics:
 - 1. Panel Thickness: 2".
 - 2. Exterior Surface: Smooth Rib.
 - 3. Steel: Minimum 24 gauge, galvanized.
 - 4. Center and End Stiles: 16 gauge.

5. Finish and Color: Factory-applied baked-on white polyester or epoxy coating.
 6. Height: 12'-9" (required for 12'-8" actual, clear masonry opening).
 7. Width: 12'-2" (required for 12'-0" actual, clear masonry opening). Door must be wide enough to allow tracks' continuous angles to be secured to reinforced concrete columns as indicated on drawings.
- B. Reinforce sections with continuous horizontal reinforcing, as required by door width and design wind loading. Provide galvanized steel angles, bars, struts, channels, or U-bars, formed to depth, and bolted in place.

2.3 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Provide manufacturer's standard, 3" galvanized-steel track system designed for clearances shown. Provide complete track assembly including brackets, bracing and reinforcing for rigid support of ball-bearing roller guides for required door type and size. Slope tracks at proper angle from vertical, or otherwise design to ensure tight closure at jambs when door unit is closed. Weld or bolt to track supports.
1. Provide lift clearance track.
- B. Track Reinforcement and Supports: Provide galvanized-steel track reinforcement and support members. Secure, reinforce and support tracks as required for size and weight of door to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
- C. Support and attach tracks to opening jambs with continuous angle welded to tracks and attached to wall. Support horizontal (ceiling tracks) with continuous angle welded to track and supported by laterally braced attachments to overhead structural members at curve, mid-point, and end of tracks.
- D. Weather Seals: Provide continuous rubber, neoprene, or flexible vinyl adjustable weatherstrip gasket at tops and compressible astragal on bottoms of each overhead door. Provide jamb seals.

2.4 HARDWARE

- A. General: Provide heavy-duty, rust-resistant hardware, with galvanized or cadmium-plated or stainless steel fasteners, to suit type of door.
- B. Hinges: Provide heavy steel hinges at each end stile and at each intermediate stile, per manufacturer's recommendations for size of door. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible.
- C. Rollers: Provide heavy-duty rollers, with steel ball bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide roller tires to suit size of track (3-inch diameter for 3-inch track) and as follows:
1. Case-hardened steel tires for normal installations.
- D. Lift Master jack/spring shaft type door openers, wall mounted, shall be used with manual chain fall opening device option included in all stations.

2.5 COUNTERBALANCING MECHANISM

- A. Torsion Spring: Operation by torsion-spring counterbalance mechanism, consisting of heavy duty adjustable-tension, tempered-steel torsion springs mounted on a cross header tube or steel shaft. Connect to door with galvanized aircraft-type lift cables. Provide springs calibrated for 100,000 cycles minimum.
- B. Provide cast-aluminum or grey-iron casting cable drums, grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of shaft. Provide one additional midpoint bracket for shafts up to 16feet long and two additional brackets at one-third points to support shafts over 16 feet long, unless closer spacing recommended by door manufacturer.
- C. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.6 ELECTRIC DOOR OPERATORS

- A. General: Furnish electric door-operator assembly of size and capacity recommended and provided by door manufacturer; complete with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, crutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
- B. Disconnect Device: Hand-operated disconnect device or mechanism for automatically engaging chain-and-sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount emergency chain operator so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- C. Design operator so that motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.
- D. Provide 6 digit, non-resettable counter mounted to each operator.
- E. Door Operator Type: Provide the following:
1. Jackshaft (side mount) gear-head hoist type, with enclosed worm-gear, running-in oil, primary drive; chain-and-sprocket secondary drive; auxiliary chain hoist; and floor-level quick release for manual operation.
 - a. Product: Provide Liftmaster Model GH 75 operator (no substitutions).

- F. Electric Motors: Provide high-starting torque, reversible, constant-duty, Class A-insulated electric motors with overload protection, sized to move door in either direction, from any position, at not less than 2/3 foot per second or more than 1 foot per second.
 - 1. Coordinate wiring requirements and current characteristics of motors with building electrical system.
 - 2. Provide open-drip-proof type motor, and controller with NEMA ICS 6, Type 1 enclosure.
 - 3. Motor to be minimum 3/4 H.P.
- G. Remote Control Station: Provide momentary-contact, three-button control station with push button controls labeled "Open", "Close", and "Stop".
 - 1. Provide interior units, full-guarded, surface-mounted, heavy-duty, with general purpose NEMA Type 1 enclosure, two per door as indicated on drawings (two gangs of six stations each).
 - 2. Push Button Operation switches shall be located in one common spot (ganged) in front and rear of the bay for all doors (recessed mounted).
- H. Radio control system: Provide universal radio control system. Provide one UHF radio receiver for each door operator. Provide two six-channel portable transmitters per door. Program transmitters in accordance with Owner's directions at time of installation.
 - 1. Provide one coaxial antenna per door installed below soffit and centered on door opening with stainless steel brackets, as indicated on drawings.
 - 2. Each door opener shall be supplied with two (2) remote controls and antenna extensions to exterior of bay door.
- I. Automatic Reversing Control: Provide each door with automatic safety sensor edge, located within neoprene or rubber astragal mounted to bottom door bar. Contact with bar shall immediately reverse downward door travel. Provide manufacturer's standard take-up reel or self-coiling cable.
 - 1. Provide electrically or pneumatically actuated automatic bottom bar.
- J. Photoelectric Sensor: Provide each door with the following:
 - 1. In addition to automatic bottom bar, provide watertight NEMA 4 design photoelectric system designed to detect an obstruction in door opening without contact between door and obstruction. Photoelectric system components shall be positioned to create a diagonal beam across each door opening. Verify mounting height with Architect prior to installation.
 - 2. Door system shall have safety devices installed that reverse door closing if electronic beam is broken, and bottom of door reversing switch if door closes on object. Sensors to be located at bumper height of apparatus normally housed for each bay. All wiring for the safety items shall be designed and securely installed to prevent damage during door operations.
- K. Door Open Indicator Lights: Coordinate installation of electric door operators with installation of wall-mounted "fully open" indicator lights (LED) as shown on drawings.
 - 1. Locate on the Driver's (left) side of door opening.
 - 2. Doors shall have a fully open indicator light (LED) mounted on wall/column indicating when door is in the completely "OPEN" position, located on the Driver's (left) side of the door opening as the apparatus bay would normally exit.
- L. Doors shall have weather stripping around door opening.
- M. Provide supply limit switches or auxiliary contacts for exhaust systems to operate when the door is lowered or raised. Each door is to be wired separately back to the panel (provide wiring diagram and clearly labeled wires indicating which door they connect). Hillsborough County has developed a model with a local supplier (Mayer Electric Supply).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install doors, tracks, and operating equipment complete with necessary hardware, jamb and head mold stops, anchors, inserts, hangers, and equipment supports according to shop drawings, manufacturer's instructions, and as specified.
- B. Fasten vertical track assembly to structure in accordance with shop drawings. Hang horizontal track from structural overhead framing with angle or channel hangers, bolt-fastened in place. Provide sway bracing, diagonal bracing, and reinforcing as required for rigid installation of track and door-operating equipment.
- C. After completing installation, including work by other trades, lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.
- D. Touch-up damaged coatings, finishes, and repair minor damage. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer of material or product being cleaned.

3.2 DEMONSTRATION

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and to train Owner's maintenance personnel as specified below:
 - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventative maintenance.
3. Review data in the maintenance manuals.
4. Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

SECTION 08 4100 - ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior entrance systems (hurricane-resistant).
 - a. Exterior storefront systems.
- B. Related sections include the following:
 - 1. Division 7 Section "Joint Sealants" for sealing between framing and masonry.
 - 2. Division 8 Section "Finish Hardware" for lock cylinders.
 - 3. Division 8 Section "Glazing" for glass at storefront and entry door.

1.3 SYSTEM DESCRIPTION

- A. General: Provide aluminum entrance and storefront systems capable of withstanding loads and thermal and structural movement requirements indicated without failure, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project. Failure includes the following:
 - 1. Air infiltration and water penetration exceeding specified limits.
 - 2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.
- B. Glazing: Physically and thermally isolate glazing from framing members.
- C. Wind Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding wind-load design pressures calculated according to the requirements of the Florida Building Code and ASCE 7-98.
 - 1. Refer to structural drawings for table of positive and negative design wind pressures.
 - 2. Deflection of framing members in a direction normal to wall plane is limited to 1/175 of clear span or 3/4 inch, whichever is smaller, unless otherwise indicated.
 - 3. Static-Pressure Test Performance: Provide entrance and storefront systems that do not evidence material failures, structural distress failure of operating components to function normally, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.
 - a. Test Pressure: 150 percent of inward and outward wind-load design pressures.
 - b. Duration: As required by design wind velocity; fastest 1 mile of wind for relevant exposure category.
- D. Hurricane-Resistance Test Performance: Provide entrance and storefront systems that pass large and small missile-impact tests, as required by systems' location above grade, and cyclic-pressure tests according to The Florida Building Code, Sections 1606 and 1626.
 - 1. Missile 'E' required.
- E. Dead Loads: Provide entrance- and storefront-system members that do not deflect an amount which will reduce glazing bite below 75 percent of design dimension when carrying full dead load.
 - 1. Provide a minimum 1/8-inch clearance between members and top of glazing or other fixed part immediately below.
 - 2. Provide a minimum 1/16-inch clearance between members and operable windows and doors.
- F. Live Loads: Provide entrance and storefront systems, including anchorage, that accommodate the supporting structures' deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.
- G. Engineering Responsibility: Storefront subcontractor shall engage a Florida registered structural engineer (PE) to design connections, member reinforcements, and fastening to building structure, and prepare design calculations and engineering data.
- H. Air Infiltration: Provide entrance and storefront systems with permanent resistance to air leakage through fixed glazing and frame areas of not more than 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft.
- I. Water Penetration: Provide entrance and storefront systems that do not evidence water leakage through fixed glazing and frame areas when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward-acting wind-load design pressure as defined by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," but not less than 6.24 lbf/sq. ft. Water leakage is defined as follows:
 - 1. Uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.
- J. Thermal Movements: Provide entrance and storefront systems, including anchorage, that accommodate thermal movements of systems and supporting elements resulting from the following maximum change

(range) in ambient and surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, failure of doors or other operating units to function properly, and other detrimental effects.

1. Temperature Change (Range): 100 deg F ambient; 150 deg F material surfaces.
- K. Structural-Support Movement: Provide entrance and storefront systems that accommodate structural movements including, but not limited to, sway and deflection.
- L. Dimensional Tolerances: Provide entrance and storefront systems that accommodate dimensional tolerances of building frame and other adjacent construction.

1.4 SUBMITTALS

- A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop Drawings: For entrance and storefront systems. Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, and attachments to other work. Show elevations at 2 A scale and details at 3" scale.
 1. Shop drawings shall include large-scale anchorage details indicating attachment to slabs, walls, and overhead structure.
 2. Submit calculations, structural properties, connection information and product information to verify that the system performance and anchorage can successfully resist wind loads. All calculations shall be signed and sealed by a Florida registered professional structural engineer.
 3. For entrance systems, include hardware schedule and indicate operating hardware types, quantities, and locations.
 4. Shop drawings shall include State of Florida Product Approval and installation instructions applicable to actual sizes of doors indicated.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing entrance and storefront systems similar to those required for this Project and who is acceptable to manufacturer.
 1. Engineering Responsibility: Prepare data for entrance and storefront systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project
- B. Source Limitations: Obtain each type of entrance and storefront system through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of entrance and storefront systems and are based on the specific systems indicated.
 1. Do not modify intended aesthetic effect, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 WARRANTY

- A. Provide two (2) year manufacturer and twenty (20) year finish warranties.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Kawneer Company, Inc.
 2. Vistawall Architectural Products.
 3. YKK AP America.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
 1. Sheet and Plate: ASTM B 209.
 2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Bars, Rods, and Wire: ASTM B 211.
- B. Steel Reinforcement: Complying with ASTM A 36 for structural shapes, plates, and bars; ASTM A 611 for cold-rolled sheet and strip; or ASTM A 570 for hot-rolled sheet and strip.

- C. Glazing: refer to Section 08 8000 - Glazing.
- D. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
 - 1. Provide silicone sealant in lieu of glazing gasket if required by entrance manufacturer for hurricane-resistant construction.
- E. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.

2.3 COMPONENTS

- A. Doors: Provide manufacturer's standard 1-3/4-inch- thick glazed doors with minimum 0.125-inch- thick, extruded tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie-rods.
 - 1. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on extruded- aluminum glazing stops and preformed gaskets.
 - 2. Stile Design: Medium stile; 3-1/2-inch nominal width.
- B. Brackets and Reinforcements: Provide manufacturer's standard brackets and reinforcements that are compatible with adjacent materials. Provide nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Reinforce members as required to retain fastener threads.
 - 2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.
- D. Weather Stripping: Manufacturer's standard replaceable weather stripping as follows:
 - 1. Compression Weather Stripping: Molded neoprene complying with ASTM D 2000 requirements or molded PVC complying with ASTM D 2287 requirements.
 - 2. Sliding Weather Stripping: Wool, polypropylene, or nylon woven pile with nylon- fabric or aluminum-strip backing complying with AAMA 701 requirements.

2.4 HARDWARE

- A. General: Provide heavy-duty hardware units indicated in sizes, number, and type recommended by manufacturer for entrances indicated.
- B. Ball-Bearing Butts: ANSI/BHMA A156.1, Grade 1, 5 knuckle, 4 1/2-by 4-inch ball-bearing butts. Provide nonremovable pins at hinges exposed to door outside and provide nonferrous hinges for applications exposed to weather. Provide 3 hinges at each leaf for doors up to 36 inches wide and 80 inches tall; provide 4 hinges at each leaf for taller doors.
- C. Closers, General: Comply with manufacturer's recommendations for closer size, depending on door size, exposure to weather, and anticipated frequency of use.
 - 1. Closing Cycle: Comply with Florida Accessibility code for Building construction or the Americans with Disabilities Act (ADA), whichever is more stringent.
 - 2. Opening Force: Comply with the following maximum opening-force requirements for locations indicated:
 - a. Exterior Doors: 8.5 lbf.
 - 3. Hold Open: Adjustable.
- D. Surface-Mounted Overhead Closers: ANSI/BHMA A 156.4, Grade 1.
- E. Door Stops: ANSI/BHMA A 156.16, Grade 1, floor- or wall-mounted door stop, as appropriate for door location indicated with integral rubber bumper.
- F. Mortise Cylinders: Cylinders are specified in Section 08710 - Door Hardware.
- G. Deadlatch Locks: Manufacturer's standard mortise deadlatch with minimum 2 inch long latch bolt and auxiliary bolt located below latch bolt and complying with ANSI/BHMA A156.5, Grade 1 requirements.
- H. Radius Face Strikes: Manufacturer's standard stainless-steel, radiused face strike with steel mounting plate and black-plastic dustbox.
- I. Vertical-Rod Exit Devices: At all doors, provide concealed, vertical-rod exit device complying with UL 305 requirements, with 2-point top and bottom latching that is released by a full-width crash bar or when locked down (dogged) by lock cylinder or retracting screws beneath housing.
 - 1. Device shall comply with hurricane-resistant entrance system requirements.
- J. Pull Handles: As selected by Architect from manufacturer's full range of pull handles and plates.
- K. Thresholds: At exterior doors, provide manufacturer's standard threshold with cutouts coordinated for operating hardware, with anchors and jamb clips, and not more than 2- inch- high, with beveled edges providing a floor level change with a slope of not more than 1:2, and in the following material:
 - 1. Material: Aluminum, mill finish.
- L. Weather Sweeps: Manufacturer's standard weather sweep for application to exterior door bottoms and with concealed fasteners on mounting strips.

2.5 FABRICATION

- A. A General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
 - 1. Fabricate components for screw-spline frame construction.
- B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
- C. Prepare components to receive concealed fasteners and anchor and connection devices.
- D. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.
- E. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."
- F. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- G. Storefront: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete, hurricane-resistant system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.
 - 1. Frame dimensions to be 2-1/2" x 5" maximum.
- H. Entrances: Fabricate door framing in profiles indicated. Reinforce as required to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units as required for installing hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.
 - 1. Provide compression weatherstripping at fixed stops.

2.6 ALUMINUM FINISHES

- A. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.7 STEEL PRIMING FOR STEEL REINFORCEMENT

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying primer.
- B. Surface Preparation: Perform manufacturer's standard cleaning operations to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel.
- C. Priming: Apply manufacturer's standard corrosion-resistant primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of entrance and storefront systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 STOREFRONT INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
- B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

- D. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction, unless otherwise indicated.
 - E. Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.
 - F. Install entrances plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers' written instructions.
 - 1. Install surface-mounted hardware according to manufacturer=s written instructions using concealed fasteners to greatest extent possible.
 - G. Install glazing to comply with requirements of Division 8 Section "Glazing," unless otherwise indicated.
 - H. Install perimeter sealant, using compatible backer rod where indicated on drawings.
 - I. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:
 - 1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 12 feet; 1/4 inch over total length.
 - 2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
 - 3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.
- 3.3 ADJUSTING AND CLEANING
- A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weathertight closure.
 - B. Remove excess sealant and glazing compounds, and dirt from surfaces.
- 3.4 PROTECTION
- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 08 5200 - ALUMINUM WINDOWS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes Heavy-Commercial Grade aluminum windows of the performance class indicated. Window types required include the following:
 - 1. Casement windows.
 - a. Impact Resistant - Missile 'E'
- B. Related Sections include the following: Division 8 Section "Glazing" for glazing requirements for aluminum windows, including those specified to be factory glazed.

1.3 DEFINITIONS

- A. Performance class number, included as part of the window designation system, is the actual design pressure in pounds force per square foot (pascals) used to determine structural test pressure and water test pressure.
 - 1. Structural test pressure, wind load test, is equivalent to 150 percent of the design pressure.
 - 2. Water-leakage-resistance test pressure is equivalent to 15 percent of the design pressure with 2.86 lbf/sq. ft. (137 Pa) as a minimum for Residential, Commercial, and Heavy-Commercial Grade windows.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum windows engineered, fabricated, and installed to withstand normal thermal movement, wind loading, and impact loading without failure, as demonstrated by testing manufacturer's standard window assemblies representing types, grades, classes, and sizes required for Project according to test methods indicated.
- B. Test Criteria: Testing shall be performed by a qualified independent testing agency based on the following criteria:
 - 1. Refer to structural drawings for table of positive and negative design wind pressures for doors and windows.
 - 2. Test Procedures: Test window units according to ASTM E 283 for air infiltration, both ASTM E 331 and ASTM E 547 for water penetration, and ASTM E 330 for structural performance.
- C. Performance Requirements: Testing shall demonstrate compliance with requirements indicated in AAMA 101 for air infiltration, water penetration, and structural performance for type, grade, and performance class of window units required. Where required design pressure exceeds the minimum for the specified window grade, comply with requirements of AAMA 101, Section 3, "Optional Performance Classes," for higher than minimum performance class.
 - 1. Air-Infiltration Rate for Operating Units: Not more than 0.19 cfm/ft. of operable sash joint for an inward test pressure of 1.57 lbf/sq. ft.
 - 2. Water Penetration: No water penetration as defined in the test method at an inward test pressure of 15 percent of the design pressure.
 - 3. Structural Performance: No failure or permanent deflection in excess of 0.4 percent of any member's span after removing the imposed load, for positive (inward) and negative (outward) test pressures indicated on drawings.
 - 4. Thermal Movements: Provide window units that allow thermal movement resulting from the following maximum change (range) in ambient temperature when engineering, fabricating, and installing aluminum windows to prevent buckling, opening of joints, and overstressing of components, connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to solar heat gain and nighttime sky heat loss.
 - a. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.
- D. Wind Loads: Provide aluminum window system including anchorage to building capable of withstanding minimum allowable wind load design pressures as indicated. Note that these pressures have been calculated by multiplying the ultimate wind pressures by a factor of 0.6.
 - 1. Refer to drawings for required pressures (positive and negative).
- E. Thermal Performance: provide documentation demonstrating the window units and glazing acting as an assembly provide the following:
 - 1. U-value (overall): 1.1.
 - 2. SHGC: 0.52.

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of window required, including the following:
 - 1. Construction details and fabrication methods.
 - 2. Profiles and dimensions of individual components.
 - 3. Data on hardware, accessories, and finishes.
 - 4. Recommendations for maintaining and cleaning exterior surfaces.
- C. Shop Drawings showing fabrication and installation of each type of window required including information not fully detailed in manufacturer's standard Product Data and the following:
 - 1. Layout and installation details, including anchors.
 - 2. Elevations at 1/4 inch= 1foot scale and typical window unit elevations at 3/4 inch = 1 foot scale.
 - 3. Full-size section details of typical composite members, including reinforcement and stiffeners.
 - 4. Location of weep holes.
 - 5. Panning details.
 - 6. Hardware, including operators.
 - 7. Glazing details.
 - 8. Accessories.
 - 9. Anchorage details at head, jamb, and sill.
- D. Samples for initial color selection on 12-inch- long sections of window members. Where finishes involve normal color variations, include Sample sets showing the full range of variations expected.
- E. Test reports from a qualified independent testing agency indicating that each type, grade, and size of window unit complies with performance requirements indicated based on comprehensive testing of current window units within the last 5 years. Test results based on use of down-sized test units will not be accepted.
- F. Submit calculations, structural properties, connection information and product information to verify that system performance and anchorage complies with the loading criteria specified herein. All calculations shall be signed and sealed by a professional engineer registered in the State of Florida, whose discipline is structural engineering.
- G. State of Florida Product Approval Number documentation.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed installation of aluminum windows similar in material design, and extent to those required for this Project and with a record of successful in-service performance.
- B. Single-Source Responsibility: Obtain aluminum windows from one source and by a single manufacturer.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Check window openings by field measurements before fabrication and show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure -that actual opening dimensions correspond to guaranteed dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Horizontal Sliding Windows:
 - a. EFCO Corporation, "Series 6500".
 - b. Graham Architectural Products Corp., "Series 0600.
 - c. Winco Window Company, "Series 3410 HS Series".

2.2 MATERIALS

- A. Aluminum Extrusions: Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000- psi ultimate tensile strength and not less than 0.062 inch thick at any location for main frame and sash members.
- B. Fasteners: Provide aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components of window units.
 - 1. Reinforcement: Where fasteners screw anchor into aluminum less than 0.125 inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads or provide standard, noncorrosive, pressed-in, splined grommet nuts.

2. Exposed Fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.
- C. Anchors, Clips, and Window Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel or iron complying with requirements of ASTM B 633; provide sufficient strength to withstand design pressure indicated.
- D. Sliding-Type Weatherstripping: Provide woven-pile weatherstripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701.2.
- E. Sealant: For sealants required within fabricated window units, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating. Comply with Division 7 Section "Joint Sealants" of these Specifications for selection and installation of sealants.
- F. Glass-Fiber-Mesh Insect Screen: 18-by-16 or 18-by-14 mesh of plastic-coated glass-fiber threads, woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with requirements of ASTM D 3656

2.3 HARDWARE

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum and of sufficient strength to perform the function for which it is intended.
- B. Counterbalancing Mechanism: Comply with AAMA 902.2.
 1. Sash-Balance Type: Concealed spiral type of size and capacity to hold sash stationary at any open position.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessories that comply with indicated standards.
- B. Insect Screens: Provide insect screens for each operable exterior sash or ventilator. Locate screens on inside or outside of window sash or ventilator, depending on window type. Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches.
 1. Screen Frames: Fabricate frames of tubular-shaped, extruded- or formed-aluminum members of 0.040-inch minimum wall thickness, with mitered or coped joints and concealed mechanical fasteners. Finish frames to match window units.
 - a. Provide removable PVC spline-anchor concealing edge of screen frame.
- C. C. Head and Jamb Closures: Provide manufacturer's standard extruded aluminum head and jamb closures compatible with frame profiles provided.

2.5 HORIZONTAL SLIDING WINDOWS

- A. Minimum Window Class and Grade: Comply with requirements of AAMA Performance Class HG-Heavy Commercial. Provide AAMA Performance Grade as required by wind pressures indicated on drawings. Window units shall successfully pass operating force test performance requirements specified in AAMA 101. Thermally broken construction is not required.
- B. Hardware: Provide the following equipment and operating hardware:
 1. Sash Rollers: Steel, lubricated ball-bearing rollers with nylon tires.
 2. Sash Lock: Cam-action sweep sash lock and keeper at meeting rails.

2.6 FABRICATION

- A. General: Fabricate aluminum window units to comply with indicated standards. Include a complete system for assembly of components and anchorage of window units.
 1. Provide units that are reglazable without dismantling sash or ventilator framing.
 2. Prepare window sash or ventilators for glazing, except where preglazing at the factory is indicated.
- B. Frames: Provide 3-5/8" minimum frame depth, with frame and sash extrusions of .062" minimum thickness, and with sill members of .094" minimum thickness. All horizontal rails shall be tubular.
- C. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated.
- D. Glazing Stops: Provide screw-applied or snap-on glazing stops, coordinated with glass selection and glazing system indicated. Finish to match window units.
- E. Preglazed Fabrication: Preglazed window units at the factory where possible and practical for applications indicated. Comply with glass and glazing requirements of Division 8 Section "Glazing" of these Specifications and AAMA 101.

2.7 FINISHES

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
- B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect openings before installation. Verify that rough or masonry opening is correct and sill plate is level.
- B. Masonry surfaces shall be visibly dry and free of excess mortar, sand, and other construction debris.

3.2 INSTALLATION

- A. Comply with manufacturer's specifications and recommendations for installing window units, hardware, operators, and other components of the Work.
- B. Set window units plumb, level, and true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place.
 - 1. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified under "Dissimilar Materials" Paragraph in appendix to AAMA 101.
 - 2. Set windows on .062" thick formed aluminum sill flashing provided by manufacturer, in finish to match windows.
- C. Set sill members and other members in a bed of sealant or with joint fillers or gaskets, as shown on Shop Drawings, to provide weathertight construction. Refer to Division 7 Section "Joint Sealants" for compounds, fillers, and gaskets to be installed concurrently with window units. Coordinate installation with wall flashings and other components of the Work.

3.3 ADJUSTING

- A. Adjust operating sash and hardware to provide a tight fit at contact points and at weatherstripping for smooth operation and a weathertight closure.

3.4 CLEANING

- A. Clean aluminum surfaces promptly after installing windows. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt, and other substances. Lubricate hardware and other moving parts.
- B. Clean glass of preglazed units promptly after installing windows. Comply with requirements of Division 8 Section "Glazing" for cleaning and maintenance.

3.5 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to aluminum window manufacturer, that ensure window units are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 08 7100 – FINISH HARDWARE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The work in this section shall include furnishing of all items of finish hardware as hereinafter specified or obviously necessary to complete the building, except those items that are specifically excluded from this section of the specification.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Hollow Metal Doors and Frames
- B. Aluminum Doors and Frames
- C. Wood Doors and Frames

1.3 DESCRIPTION OF WORK

- A. Furnish labor and material to complete hardware work indicated, as specified herein, or as may be required by actual conditions at building.
- B. Include all necessary screws, bolts, expansion shields, other devices, if necessary, as required for proper hardware application. The hardware supplier shall assume all responsibility for correct quantities.
- C. All hardware shall meet the requirements of Federal, State and Local codes having jurisdiction over this project, notwithstanding any real or apparent conflict therewith in these specifications.
- D. Fire-Rated Openings:
 - 1. Provide hardware for fire-rated openings in compliance with A.I.A. (NBFU) Pamphlet No. 80, NFPA Standards NO. 101, UBC 702 and UL10C. This requirement takes precedence over other requirements for such hardware. Provide only hardware that has been tested and listed by UL for the types and sizes of doors required, and complies with the requirements of the door and door frame labels.
 - 2. Where panic exit devices are required on fire-rated doors, provide supplementary marking on door UL label indicating Fire Door to be equipped with fire exit hardware and provide UL label on exit device indicating "Fire Exit Hardware".
- E. Fasteners:
 - 1. Hardware as furnished shall conform to published templates generally prepared for machine screw installation.
 - 2. Furnish each item complete with all screws required for installation. Typically, all exposed screws installation.
 - 3. Insofar as practical, furnished concealed type fasteners for hardware units which have exposed screws shall be furnished with Phillips flat heads screws, finished to match adjacent hardware.
 - 4. Door closers and exit devices to be installed on wood or composite fire doors shall be attached with closed head through bolts (sex bolts).
- F. Florida Building Code (Latest edition)
 - 1. Provide Miami-Dade Notice of Authorization (NOA) if required by authority having jurisdiction require.
 - 2. Engineering Reports that opening meet requirement for wind load, water infiltration and impact as required in FBC

1.4 QUALITY ASSURANCE

- A. The supplier to be a directly franchised distributor of the products to be furnished and have in their employ an AHC (Architectural Hardware Consultant). This person is to be

available for consultation to the architect, owner and the general contractor at reasonable times during the course of work.

- B. The finish hardware supplier shall prepare and submit to the architect six (6) copies of a complete schedule identifying each door and each set number, following the numbering system and not creating any separate system himself. He shall submit the schedule for review, make corrections as directed and resubmit the corrected schedule for final approval. Approval of schedule will not relieve Contractor of the responsibility for furnishing all necessary hardware, including the responsibility for furnishing correct quantities.
- C. No manufacturing orders shall be placed until detailed schedule has been submitted to the architect and written approval received.
- D. After hardware schedule has been approved, furnish templates required by manufacturing contractors for making proper provisions in their work for accurate fitting, finishing hardware setting. Furnish templates in ample time to facilitate progress of work.
- E. Hardware supplier shall have an office and warehouse facilities to accommodate the materials used on this project. The supplier must be an authorized distributor of the products specified.
- F. The hardware manufactures are to supply both a pre-installation class as well as a post-installation walk-thru. This is to insure proper installation and provide for any adjustments or replacements of hardware as required.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Wrap, protect finishing hardware items for shipment. Deliver to manufacturing contractors hardware items required by them for their application; deliver balance of hardware to job; store in designated location. Each item shall be clearly marked with its intended location.

1.6 WARRANTY

- A. The material furnished shall be warranted for one year after installation or longer as the individual manufacturer's warranty permits.
- B. Overhead door closers shall be warranted in writing, by the manufacturer, against failure due to defective materials and workmanship for a period of ten (10) years commencing on the Date of Final Completion and Acceptance, and in the event of failure, the manufacture is to promptly repair or replace the defective with no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. To the greatest extent possible, obtain each kind of hardware from one manufacturer only.
- B. All numbers and symbols used herein have been taken from the current catalogues of the following manufacturers.

PRODUCT	ACCEPTABLE MANUFACTURER	ACCEPTABLE SUBSTITUTE
1) Hinges	Ives	Hager, Stanley
2) Locks & Latches	Schlage Lock	Corbin Russwin
3) Cylinders, Keys, Keying	Schlage Lock	None
4) Exit Devices	Von Duprin	None
5) Door Closers	LCN	None
6) OH Stops/Holders	Glynn Johnson	Rixson
7) Wall Stops/Floor Stops, Flushbolts	Ives	Rockwood, Hager
8) Kick Plates	Ives	Rockwood, Hager
9) Threshold/ Weather-strip	Zero	National Guard, Pemko
10) Silencers	Ives	Rockwood, Hager
11) Key Cabinet	Lund	Key Control

- C. If material manufactured by other than that specified or listed herewith as an equal, is to be bid upon, permission must be requested from the architect seven (7) days prior to bidding. If substitution is allowed, it will be so noted by addendum.

2.2 FINISH OF HARDWARE:

- A. Exterior Hinges to be Stainless Steel (32D) and Interior hinges to be Satin Chrome (26D) Door Closers to be Aluminum, Locks to be Satin Chrome (26D). Exit Devices to be Satin Chrome (26D). Overhead Holders to be Satin Chrome (26D), Stainless Steel (32D) and the Thresholds to be Mill Finish Aluminum.

2.3 HINGES AND PIVOTS:

- A. Exterior butts shall be Stainless Steel. Butts on all out swinging doors shall be furnished with non-removable pins (NRP).
- B. Interior butts shall be as listed.
- C. Doors 5' or less in height shall have two (2) butts. Furnish one (1) additional butt for each 2'6" in height or fraction thereof. Dutch door shall have two (2) butts per leaf.

2.4 KEYING:

- A. Locks and cylinders shall be Schlage Lock Company. All bittings shall be issued by lock the manufacturer in order to create a grand master key system.
- B. Provide Two (2) each change keys per lock and Six (6) each construction master keys.
- C. All Exterior Cylinders to be Large Format Interchangeable Core, interior cylinders to be 6-pin standard cylinders.

2.5 LOCKSETS:

- A. Locksets shall be Heavy Duty Mortise type, unless specified otherwise, in "L" series, lever design as manufactured by Schlage Lock.
 - 1. Acceptable substitutions:
 - A. Corbin Russwin ML2000 series

2.6 EXIT DEVICES:

- A. All devices shall be Von Duprin 98 Series in types and functions specified. All devices must be listed under "Panic Hardware" in accident equipment list of Underwriters Laboratories. All labeled doors with "Fire Exit Hardware" must have labels attached and be in strict accordance with Underwriters Laboratories.
- B. All exit devices shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified testing laboratory.
- C. All surface strikes shall be roller type and come complete with a plate underneath to prevent movement. And shall be provided with a dead-latching feature to prevent latchbolt tampering.
 - 1. Acceptable Substitutions:
 - A. None

2.7 DOOR CLOSERS:

- A. All closers shall be LCN 4000 series with slim cover having non-ferrous covers, steel arms separate valves for adjusting backcheck, closing and latching cycles and adjustable spring to provide up to 50% increase in spring power. Closers shall be furnished with parallel arm mounted on all doors opening into corridors or other public spaces and shall be mounted to permit 180 degrees door swing wherever wall conditions permit. Furnish with non-hold open arms unless otherwise indicated.
- B. Door closer cylinders shall be of high strength cast construction to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory.
- C. Door closers shall utilize temperature stable fluid capable of withstanding temperature ranges of 120 degrees Fahrenheit to -30 degrees Fahrenheit, without requiring seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with the standards UBC 7-2 (1997) and UL 10C.
- D. Door closers shall incorporate tamper resistant non-critical screw valves of V-slot design to reduce possible clogging from particles within the closer. Closers shall have separate and independent screw valve adjustments for latch speed, general speed, and hydraulic backcheck. Backcheck shall be properly located so as to effectively slow the swing of the door at a minimum of 10 degrees in advance of the dead stop location to protect the door frame and hardware from damage. Pressure relief valves (PRV) are not acceptable.
 - 1. Acceptable Substitutions:
 - A. None

2.8 TRIM AND PLATES:

- A. Kick plates, mop plates, and armor plates, shall be .050 gauge with 32D finish. Kick plates to be 10" high, mop plates to be 4" high. All plates shall be two (2) inches less full width of door.
- B. Push plates, pull plates, door pulls, and miscellaneous door trim shall be shown in the hardware schedule.

2.9 DOOR STOPS:

- A. Door stops shall be furnished for all door to prevent damage to doors or hardware from striking adjacent walls or fixtures. Wall bumpers equal to Ives WS407 Series are preferred, but where not practical furnish floor stops equal to Ives FS436 or FS438 series. Where conditions prohibit the use of either wall or floor type stops, furnish surface mounted overhead stops equal to Glynn Johnson, 450 Series.

2.10 THRESHOLDS AND WEATHERSTRIP:

- A. Thresholds and weatherstrip shall be as listed in the hardware schedule.

2.11 DOOR SILENCERS:

- A. Furnish rubber door silencers equal to Ives SR64 for all new interior hollow metal frames, (2) per pair and (3) per single door frame.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. All hardware shall be applied and installed in accordance with the Finish Hardware schedule. Care shall be exercised not to mar or damage adjacent work.
- B. Contractor to provide a secure lock-up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items that are not immediately replaceable, so that the completion of the work will not be delayed by hardware losses both before and after installation.
- C. No hardware is to be installed until the hardware manufactures have provided a pre-installation class. This is to insure proper installation of the specified products.

3.2 ADJUSTING AND CLEANING:

- A. Contractor shall adjust all hardware in strict compliance with manufacturer's instructions. Prior to turning project to owner, contractor shall clean and make any final adjustments to the finish hardware.

3.3 PROTECTION:

- A. Contractor shall protect hardware as it is stored on construction site in a covered and dry place.
- B. Contractor shall protect exposed hardware installed on doors during the construction phase.

3.4 KEY CABINET:

- A. Set up and index one (1) Key Cabinet that allows room for expansion for 150% of the number of keys for the project.

3.5 HARDWARE SCHEDULE:

- A. The following schedule is furnished for whatever assistance it may afford the contractor; do not consider it as entirely inclusive. Should any particular door or item be omitted in any scheduled hardware group, provide door or item with hardware same as required for similar purposes. Quantities listed are for each pair of doors, or for each single door.
- B. This hardware schedule prepared by.

Allegion, PLC
3451 Technological Ave, Suite 7
Orlando FL 32817
Ph: 407-571-2000
Fax 407-571-2006

Abbreviation	Name
B/O	By Others
GLY	Glynn-Johnson Corp
IVE	H.B. Ives
LCN	LCN Commercial Division
SCE	Schlage Electronic Security
SCH	Schlage Lock Company
VON	Von Duprin
ZER	Zero International Inc

Legend:

-  Link to catalog cut sheet
⚡ Electrified Opening

Hardware Group No. 01

101A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON	 ⚡	689	VON
1	EA	EXIT DEVICE	FL3690 91 MEL		⚡ 626	B/O
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030		626	SCH
1	EA	90 DEG OFFSET PULL	8190EZHD 10" O		630-316	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61		689	LCN
1	EA	THRESHOLD	65A-223		A	ZER

BALANCE OF DOOR HARDWARE TO BE SUPPLIED BY ALUMINUM SUPPLIER
CARD READER AND POWER SUPPLY BY SECURITY SUB DIV.28 TO RELEASE DEVICE FOR
ACCESS
OPENING TO COMPLY WITH LEVEL E TESTING

Hardware Group No. 02

129

Provide each PR door(s) with the following:

QT Y		DESCRIPTION	CATALOG NUMBER		FINIS H	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
2	EA	POWER TRANSFER	EPT10 CON		✓ 689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-WS-9927-EO-CON 24 VDC		✓ 626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-WS-9927-L-KC-03- CON 24 VDC		✓ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030		626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	EA	GASKETING	188SBK PSA		BK	ZER
1	SET	MEETING STILE	328AA-S		AA	ZER
1	EA	THRESHOLD	65A-223		A	ZER
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		✓ LGR	SCE

OPENING TO COMPLY WITH LEVEL E TESTING
CARD READER/KEYPAD BY SECURITY SUB DIV. 28 TO RELEASE DEVICE FOR ACCESS

Hardware Group No. 03A

115

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON	 ✖	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-WS-9927-L-03-CON 24 VDC	 ✖	626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	RAIN DRIP	142AA		AA	ZER
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	THRESHOLD	566A-223		A	ZER
1	EA	VIEWER	U698		626	IVE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC	 ✖	LGR	SCE

OPENING TO COMPLY WITH LEVEL E TESTING
CARD READER/KEYPAD BY SECURITY SUB DIV. 28 TO RELEASE DEVICE FOR ACCESS

Hardware Group No. 03B

128E 130

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON	 ✖	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-WS-9927-L-KC-03- CON 24 VDC	 ✖	626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	RAIN DRIP	142AA		AA	ZER
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	THRESHOLD	566A-223		A	ZER
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC	 ✖	LGR	SCE

OPENING TO COMPLY WITH LEVEL E TESTING
CARD READER/KEYPAD BY SECURITY SUB DIV. 28 TO RELEASE DEVICE FOR ACCESS

Hardware Group No. 04A

110

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	FIRE EXIT HARDWARE	98-L-F-03		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	THRESHOLD	65A-223		A	ZER

Hardware Group No. 04B

124B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	FIRE EXIT HARDWARE	98-L-F-03		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	THRESHOLD	65A-223		A	ZER

Hardware Group No. 05A

111

123

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 03A		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

Hardware Group No. 05B

127

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10 CON	 ✂	689	VON
1	EA	EU MORTISE LOCK	L9092P6EU 03A RX CON 12/24 VDC	 ✂	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

CARD READER AND POWER SUPPLY BY SECURITY SUB DIV.28 TO RELEASE LOCK FOR ACCESS

Hardware Group No. 06

102

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050P6 03A 09-544		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

Hardware Group No. 07

126

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224XY		628	IVE
1	EA	CLASSROOM LOCK	L9070P 03A		626	SCH
1	EA	SURFACE CLOSER	4040XP H		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

Hardware Group No. 08

103 104 112 113 117 118
119 120 121 125

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	L9040 03A L583-363 OS-LOC		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

Hardware Group No. 09

101B 114 122

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	L9010 03A		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

Hardware Group No. 10

124A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 8" X 16"		630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

Hardware Group No. 11

107

108

109

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM DEAD LOCK	L463P		626	SCH
1	EA	PULL PLATE	8303 10" 4" X 16"		630	IVE
1	EA	OH STOP	450S		652	GLY

Hardware Group No. 12

128A

128B

128C

128D

Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
	EA	NOTE	Hardware by Door Manuf.		626	B/O

END OF SECTION

SECTION 08 8000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes glazing for the following products, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Window units.
 - a. Casement windows.
 - b. Vision lites.
 - c. Storefront systems.
 - d. Storefront entrance doors.
 - e. Fixed glass, fire rated interior windows.
- B. Related Sections: The following sections contain requirements that relate to this Section.
 - 1. Glass for storefront entrances is specified in Division 8 Section "Aluminum Entrances and Storefronts".

1.3 DEFINITIONS

- A. Manufacturer is used in this Section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced glazing standard.

1.4 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each glass product and glazing material indicated.
- C. Samples for verification purposes of 12-inch square samples of each type of glass indicated except for clear monolithic glass products, and 12-inch long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative in color of the adjoining framing system..
- D. Product certificates signed by glazing materials manufacturers certifying that their products comply with specified requirements.
 - 1. Separate certifications are not required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program of a recognized certification agency or independent testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. FGMA Publications: "FGMA Glazing Manual."
- B. Safety Glass: Products complying with ANSI 297.1 and testing requirements of 16 CFR Part 1201 for Category II materials.
 - 1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.
- C. Fire-Resistive Glazing Products for Door Assemblies: Products identical to those tested per ASTM E 152, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Fire-Resistive Glazing Products for Window Assemblies: Products identical to those tested per ASTM E 163, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Glazier Qualifications: Engage an experienced glazier who has completed glazing similar in material, design, and extent to that indicated for Project with a record of successful in-service performance.
- F. Single-Source Responsibility for Glass: Obtain glass from one source for each product indicated below:
 - 1. Primary glass of each (ASTM C 1036) type and class indicated.
 - 2. Heat-treated glass of each (ASTM C 1048) condition indicated.
- G. Single-Source Responsibility for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation, or other causes.

PART 2 - PRODUCTS

2.1 PRIMARY FLOAT GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), and Quality q3 (glazing select).

2.2 HEAT-TREATED FLOAT GLASS

- A. Uncoated, Clear, Heat-Treated Float Glass [G1]: ASTM C 1048, Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below, 1/4" thick:
 - 1. Kind FT (fully tempered) in the following locations:
 - a. Interior door vision panels in doors in non fire-rated openings.
 - b. Interior windows in non fire-rated openings.
 - 2. Manufacturers: Subject to compliance with requirements, provide heat-treated glass by one of the following companies.
 - a. AFG Industries, Inc.
 - b. Ford Glass Division
 - c. Guardian Industries Corp.
 - d. HGP & Affiliates, Inc.
 - e. Pilkington LOF
 - f. PPG Industries, Inc.
 - g. Saint-Gobain
 - h. Viracon, Inc.

2.3 LAMINATED GLASS

- A. Laminated Lite [G2]: 1-5/16" thick lite. ASTM C1172, one exterior lite, air space, and an interior laminated lite-two tempered panes laminated with 0.090" Clear PVB Interlayer and complying with other requirements specified and with the following:
 - 1. Must meet impact requirements.
 - 2. Coordinate thickness with manufacturer's standard stop sizes.
 - 3. Highly reflective (mirrored) tints are not allowed.
 - 4. Bronze glass is not allowed.
 - 5. Minimum assembly U-Value:
 - a. Aluminum window assemblies: 1.1 (or better).
 - 6. Minimum assembly SHGC-Value:
 - a. Aluminum window assemblies: 0.52 (or better).
 - 7. Visible Light Transmittance (VLT): 0.50 (or better).
- B. Laminated Lite [G2A]: 1" thick lite. ASTM C1172, one exterior lite, air space, and an interior laminated lite-two tempered panes laminated with 0.090" Clear PVB Interlayer and complying with other requirements specified and with the following:
 - 1. Same as [G2].
- C. Laminated Lite [G2B]: 1-7/16" thick lite. ASTM C1172, one exterior lite, air space, and an interior laminated lite-two tempered panes laminated with 0.090" Clear PVB Interlayer and complying with other requirements specified and with the following:
 - 1. Same as [G2].

2.4 FIRE-PROTECTION-RATED CERAMIC GLAZING

- A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies.
 - 1. Install at all interior fire rated doors and windows.
- B. Laminated Ceramic glazing: Laminated glass made from 2 plies of clear, ceramic flat glass; 5/16-inch (8-mm) total nominal thickness; complying with testing requirements in 16 CFR 1201 for Category II materials, and certified as approved safety glazing.
 - 1. Subject to compliance with requirements, provide one of the following:
 - a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products): FireLite Plus.

- 1) BASIS OF DESIGN.
 - b. Schott North America, Inc.; Laminated Pyran Crystal.
 - c. Vetrotech Saint-Gobain; SGG Keralite FR-L.
 2. Type [G3]: 45-minute rated product and frame. OH-45 or W-60.
 3. Type [G4]: 60-minute rated product and frame. W-60.
- 2.5 ELASTOMERIC GLAZING SEALANTS
- A. General: Provide products of type indicated, complying with the following requirements:
 1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturer's recommendations for selecting glazing sealants and tapes that are suitable for applications indicated and conditions existing at time of installation.
 3. Colors: Provide color of exposed joint sealants to comply with the following:
 4. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.
 - B. Elastomeric Glazing Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants that comply with ASTM C 920 requirements.
- 2.6 GLAZING TAPES
- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent, nonstaining and nonmigrating in contact with nonporous surfaces, with or without spacer rod as recommended by tape and glass manufacturers for application indicated, packaged on rolls with a release paper backing, and complying with AAMA 800.
 - B. Expanded Cellular Glazing Tape: Closed-cell, polyvinyl chloride foam tape, factory coated with adhesive on both surfaces, packaged on rolls with release liner protecting adhesive, and complying with AAMA 800 for product 810.5.
- 2.7 GLAZING GASKETS
- A. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542, black.
 - B. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
 1. Neoprene, ASTM C 864.
 2. EPDM, ASTM C 864.
 3. Silicone, ASTM C 1115.
 4. Thermoplastic polyolefin rubber, ASTM C 1115.
 5. Any material indicated above.
 - C. Soft Compression Gaskets: Extruded or molded closed-cell, integral-skinned gaskets of material indicated below, complying with ASTM C 509, Type 11, black, and of profile and hardness required to maintain watertight seal:
 1. Neoprene.
 2. EPDM.
 3. Silicone.
 4. Thermoplastic polyolefin rubber.
 5. Any material indicated above.
- 2.8 MISCELLANEOUS GLAZING MATERIALS
- A. General: Provide products of material size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials involved for glazing application indicated, and with a proven record of compatibility with surfaces contacted in installation.
 - B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
 - C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85 plus or minus 5.
 - D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 - E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side-walking).
- 2.9 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS
- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine glass framing, with glazier present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
 - 2. Presence and functioning of weep system where required.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions as indicated on Drawings provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass from edge damage during handling and installation as follows:
 - 1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by manufacturer's label.
 - 2. Remove damaged glass from Project site and legally dispose of off site. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass sizes larger than 50 united inches (length plus height) as follows:
 - 1. Locate spacers inside, outside, and directly opposite each other. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Square cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that when compressed by glass their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously but not in one continuous length. Do not stretch tapes to make them fit opening.
- C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each lite is installed.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.
- B. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- C. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel weep systems until sealants cure. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass. Install pressurized gaskets to protrude slightly out of channel to eliminate dirt and moisture pockets.

3.7 PROTECTION AND CLEANING

- A. Protect exterior glass from breakage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkali deposits, or stains, and remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents and vandalism, during construction period.
- E. Wash glass on both faces in each area of Project not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION

SECTION 08 9119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fixed, extruded-aluminum intake and exhaust louvers at Apparatus Area.
 - 2. Fixed, extruded-aluminum intake and exhaust louvers at Hosuing Area.
 - 3. Acoustic louvers.
 - 4. Soffit louvers.
- B. Related Sections include the following:
 - 1. Division 8 Section "Steel Doors and Frames" for louvers in hollow-metal doors and frames.
 - 2. Division 8 Section "Flush Wood Doors" for louvers in wood doors.
 - 3. Division 15 Sections for louvers that are a part of mechanical equipment.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide louvers capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act on vertical projection of louvers.
 - 1. As indicated in the Contract Documents.
 - 2. Missile Impact Loads: Provide large and small hurricane missile protection in accordance with the Florida Building Code, Section 1626 - Impact Tests for Windborne Debris.
 - a. Impact-resistant louvers are indicated on drawings.
 - 3. Structural Design Criteria: Louvers shall pass Miami-Dade Protocols TAS-201 (Large Missile Impact), TAS-202 (Uniform Pressure), and TAS-203 (Cyclic Wind Pressure).
 - a. Missile 'E' required.
 - 4. Wind Driven Rain Criteria: Louvers shall be AMCA 540 and AMCA 550 listed without the need for a damper or sloped duct.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show blade profiles, angles, and spacing.
 - 1. For installed louvers and vents indicated to comply with design loads, include structural analysis data including anchorage to structure (fastener size, type, and spacing) signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Verification: For each type of metal finish required.
- D. Qualification Data: For professional engineer.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.
 - 1. Provide State of Florida Product Approval number.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2, "Structural Welding Code--Aluminum."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.

- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 WARRANTY

- A. Finish Warranty: Twenty (20) years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements including masonry opening details indicated on drawings, provide products by one of the following:
 - 1. Louvers:
 - a. Airlite Company, LLC.
 - b. Industrial Louvers, Inc.
 - c. Ruskin Company.

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-TS or T-52.
- B. Aluminum Sheet: ASTM 8 209 (ASTM 8209M), alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B 26/8 26M, alloy 319.
- D. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 - 1. Use types and sizes to suit unit installation conditions.
 - 2. Use Phillips pan-head screws for exposed fasteners, unless otherwise indicated.
- E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in. openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Universal flange frame, unless otherwise indicated.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Where indicated, provide subsills made of same material as louvers or extended sills for recessed louvers.
- F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.4 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Wind-Driven Rain-Resistant, Missile 'E' Resistant Louver [L02, L03, and L04]:
 - 1. Products:
 - a. Ruskin - Model EME6325D.
 - 2. Louver Depth: 5" to 12" overall assembly including missile protection system.
 - 3. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.080 inch for blades and 0.080 inch for frames.
 - 4. Performance Requirements:
 - a. Percent Free Area: Not less than 38%, based upon actual louver size indicated on drawings.
 - b. Air Performance: Not more than 0.15 inch wg static pressure drop at 850 fpm free-area velocity.
 - c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 500 fpm.
 - d. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
 - 5. Finish system: 70% PVDF color anodize.
 - 6. Screening Type: Bird Screen.
- B. Horizontal Louver [L01]:
 - 1. Product: Ruskin ELF637X.
 - 2. Frame depth: 6".
 - 3. Screening Type: Bird screen.

4. Finish system: Kynar.
5. Free Area: 55% Minimum.
6. Located inside Apparatus Bay - non-impact.

2.5 ACOUSTIC LOUVERS

- A. Horizontal, Acoustic Louver [L02A]:
 1. Profile: Blade.
 2. Manufacturer: Price
 - a. Model QA845.
 3. Material: aluminum.
 4. Depth: 8".
 5. Pair with [L02].
 - a. Acoustic louver is in board (protected by) [L02].

2.6 SOFFIT LOUVERS

- A. Horizontal Louver [SL-1]:
- B. Manufacturer: Greenheck.
- C. Model: ESD-435X.
 1. Material: Aluminum.
 2. Depth: 4".
 3. Free Area: 55.8%
 4. Provide blanking panels as required to provide the specified air flow (see mechanical drawings).

2.7 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 1. Screen Location for Fixed Louvers: Interior face.
 2. Screening Type: Bird screening.
- B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
 2. Finish: Same finish as louver frames to which louver screens are attached.
 3. Type: Rewirable frames with a driven spline or insert for securing screen mesh.
- D. Louver Screening for Aluminum Louvers:
 1. Bird Screening: Fiberglass, 16x18 mesh (51% free area), 0.0048-inch wire.

2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish louvers after assembly.

2.9 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
- B. High Performance Organic-Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 1. Fluoropolymer Two-Coat Coating System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

SECTION 09 2116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Fire rated area separation walls.
- D. Acoustic insulation.
- E. Gypsum sheathing.
- F. Cementitious backing board.
- G. Gypsum wallboard.
- H. Joint treatment and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 07 8410 - Through-Penetration Fire Stop Systems.
- C. Section 07 9005 - JOINT SEALERS: Acoustic sealant.
- D. Section 09 9120 - Painting.

1.3 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members.
- B. AISI S220 - North American Standard for Cold-Formed Steel Framing - Nonstructural Members.
- C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing.
- D. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units.
- E. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- G. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
- H. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
- I. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- J. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
- K. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- L. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
- M. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
- N. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- O. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base.
- P. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- Q. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing Board.
- R. ASTM C1325 - Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units.
- S. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
- T. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels.
- U. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- V. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
- W. ASTM E413 - Classification for Rating Sound Insulation.
- X. GA-216 - Application and Finishing of Gypsum Board.
- Y. UL (FRD) - Fire Resistance Directory.
- Z. UL (FRD) - Fire Resistance Directory.

1.4 SUBMITTALS

- A. See Section 01 3300 - Administrative Requirements, for submittal procedures.
- B. Product Data:
 - 1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

- C. Test Reports: For stud framing products that do not comply with AISI S220 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.5 QUALITY ASSURANCE

- A. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
 - 1. Fire-Resistance-Rated Partitions: UL listed assembly No. as indicated on the drawings.
 - 2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.2 METAL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
- B. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
 - 1. Exception: The minimum metal thickness and section properties requirements of ASTM C 645 are waived provided steel of 40 ksi minimum yield strength is used, the metal is continuously dimpled, the effective thickness is at least twice the base metal thickness, and maximum stud heights are determined by testing in accordance with ASTM E 72 using assemblies specified by ASTM C 754.
 - 2. Studs: C-shaped with knurled or embossed faces.
 - 3. Runners: U shaped, sized to match studs.
 - 4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
 - 5. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.
- C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
 - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
 - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
 - a. Provide G60/Z180 coating at: all wet walls and all exterior walls.
 - b. G40/Z120 hot dipped galvanized coating is allowed at interior dry areas.

2.3 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. American Gypsum Company: www.americangypsum.com/#sle.
 - 2. Georgia-Pacific Gypsum: www.gpgypsum.com.
 - 3. National Gypsum Company: www.nationalgypsum.com.
 - 4. USG Corporation: www.usg.com.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces, unless otherwise indicated.
 - 2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 - a. at exterior/unconditioned ceiling and spaces.
 - 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 4. Thickness:
 - a. Vertical Surfaces: 1/2 inch.
 - b. Ceilings: 1/2 inch.
 - 5. Edges: Tapered.
 - 6. Mold-Resistant, Paper-Faced Products:
 - a. National Gypsum Company; Gold Bond Brand XP Gypsum Board or equal.
- C. Backing Board For Wet Areas: with Tile.
 - 1. Application: Surfaces behind tile in wet areas.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 1/2 inch.
 - b. Products:
 - 1) Dens Guard Tile Backer (or equal)
- D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 1. Application: Ceilings, unless otherwise indicated.
 2. Thickness: 1/2 inch.
 3. Edges: Tapered.
 4. Products:
 - a. American Gypsum; Interior Ceiling Board.
 - b. CertainTeed Corporation; ProRoc Interior Ceiling.
 5. Use exterior gypsum ceiling board (sheathing) in apparatus bays and other areas exposed to exterior moisture/humidity.
- E. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
 1. Application: Exterior sheathing, unless otherwise indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 4. Core Type: Regular.
 5. Regular Board Thickness: 5/8 inch.
 6. Edges: Square.
 7. Glass Mat Faced Products:
 - a. CertainTeed Corporation; GlasRoc Brand.
 - b. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/#sle.
 - c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Sheathing: www.goldbondbuilding.com/#sle.

2.4 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Match stud width
- B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
- C. Acoustic Isolation Clip: Resilient Sound Isolation Clip.
 1. Product: RISC-1 manufactured by PAC International.
 2. Select product to comply with the overall STC design of the wall.
- D. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
 1. Types: As detailed or required for finished appearance.
 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
 - a. At soffit interface with wall use 'T' molding.
 - 1) Fry-Reglet: TDM-625-75. (Coordinate ceiling/soffit board thickness where required.)
 3. Products:
 - a. Same manufacturer as framing materials.
 - b. Fry-Reglet.
- E. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, unless noted otherwise.
 1. Corner Beads: Low profile, for 90 degree outside corners.
- F. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners - self adhesive.
 2. Coordinate joint materials with the requirements of the specified Air Barrier Manufacturer.
 3. Joint Compound: Setting type, field-mixed.
- G. High Build Drywall Surfacers: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
- H. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
- I. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.
- J. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C1007/AISI S220 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/1200.
 - 2. Laterally brace entire suspension system.
 - 3. Install bracing at exterior locations to resist wind uplift.
- C. Studs: Space studs at 16 inches on center.
 - 1. Extend partition framing to structure in all locations.
 - 2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings for weight of doors or operable panels, using not less than double studs at jambs.
- E. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
 - 1. Install with Isolation Clips as indicated on drawings.
- F. Blocking: Install wood blocking for support of:
 - 1. Wall-mounted cabinets.
 - 2. Plumbing fixtures.
 - 3. Toilet partitions.
 - 4. Toilet accessories.
 - 5. Wall-mounted door hardware.
- G. Blocking: Install blocking for support of hardware. Bolt or screw steel channels to studs.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 - 1. Place two beads continuously on substrate before installation of perimeter framing members.
 - 2. Place continuous bead at perimeter of each layer of gypsum board.
 - 3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.
- C. Acoustic Isolation Clips: Install in accordance with manufacturer's instructions.

3.4 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
- E. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
- F. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
 - 1. Seal joints, cut edges, and holes with water-resistant sealant.
- G. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- H. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.
- I. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board with sealant.

3.5 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. At exterior soffits, not more than 30 feet apart in both directions.

- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.6 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
 - 1. Coordinate joint materials with the requirements of the specified Air Barrier Manufacturer.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
 - 2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
 - 3. Taping, filling, and sanding are not required at base layer of double-layer applications.
- D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.7 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.8 FINISH LEVEL SCHEDULE

- A. Level 2: Utility areas, concealed areas, and behind cabinetry.
- B. Level 2: Backing board to receive tile finish.
- C. Level 4: Walls and ceilings to receive paint finish.

END OF SECTION

SECTION 09 2200 - PORTLAND CEMENT PLASTER

PART 1- GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 SUMMARY
 - A. This Section includes the following:
 - 1. Portland cement plaster.
 - 2. Stucco finishes.
 - 3. Plastic accessories.
- 1.3 SUBMITTALS
 - A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
 - B. Product Data for each product specified.
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver cementitious materials to Project site in original packages, containers, or bundles, labeled with manufacturer's name, product brand name and lot number.
 - B. Store materials inside, under cover, and dry, protected from weather, direct sunlight, surface contamination, aging, corrosion, and damage from construction traffic and other causes.
- 1.5 PROJECT CONDITIONS
 - A. Environmental Requirements, General: Comply with requirements of referenced plaster application standards and recommendations of plaster manufacturer for environmental conditions before, during, and after plaster application.
 - B. Warm-Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by climatic and job conditions to prevent dry out during cure period. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.
 - C. Exterior Plaster Work: Do not apply plaster when ambient temperatures is below 40 deg F.
 - D. Protect contiguous work from soiling and moisture deterioration caused by plastering. Provide temporary covering and other provisions necessary to minimize harmful spattering of plaster on other work.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Plastic Accessories:
 - a. Alabama Metal Industries Corp. (AMICO).
 - b. Plastic Components, Inc.
 - c. Vinyl Corp.
 - 2. Stucco:
 - a. California Stucco Products Corp.
 - b. Florida Stucco Corp.
 - c. Highland Stucco.
 - d. IPA Systems, Inc.
 - e. United States Gypsum Co.
- 2.2 ACCESSORIES
 - A. General: Comply with material provisions of ASTM C 1063 and the requirements indicated below; coordinate depth of accessories with thickness and number of plaster coats required.
 - 1. Plastic Components: ASTM D 4216, high-impact polyvinyl chloride (PVC) for building products.
 - B. Cornerbeads: Small nose cornerbeads fabricated from the following metal with expanded flanges of large-mesh diamond-metal lath allowing full plaster encasement.
 - 1. PVC Plastic: Minimum 0.035 inch thick.
 - C. Casing Beads: Square-edged style, with expanded flanges of the following material:
 - 1. PVC Plastic: Minimum 0.035 inch thick.
 - D. Control Joints: Prefabricated, of material and type indicated below:
 - 1. PVC Plastic: Minimum 0.035 inch thick.
 - 2. One-Piece Type: Folded pair of nonperforated screeds in M-shaped configuration, with expanded or perforated flanges.

- E. Reveals, Drip Screeds, Control Screeds, and Channel Screeds: Shapes as indicated on drawings, of material indicated below.
 - 1. PVC Plastic: Minimum 0.035 inch thick.

2.3 PLASTER MATERIALS

- A. Base-Coat Cements: Type as indicated below:
 - 1. Portland cement, ASTM C 150, Type I.
- B. Stucco Finish Coat: Manufacturer's standard factory-packaged stucco, including portland cement, aggregate, and other proprietary ingredients.
- C. Sand Aggregate for Base Coats: ASTM C 897.

2.4 MISCELLANEOUS MATERIALS

- A. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, $\frac{1}{8}$ inch long, free of contaminants, manufactured for use in portland cement plaster.
- B. Water for Mixing and Finishing Plaster: Potable.
- C. Bonding Agent: ASTM C 932.
- D. Acid-Etching Solution: Muriatic acid (10 percent solution of commercial hydrochloric acid) mixed 1 part to not less than 6 nor more than 10 parts water.

2.5 PLASTER MIXES AND COMPOSITIONS

- A. General: Comply with ASTM C 926 for base- and finish-coat mixes as applicable to plaster bases, materials, and other requirements indicated.
- B. Base-Coat Mixes and Compositions: Proportion materials for respective base coats in parts by volume per sum of cementitious materials for aggregates to comply with the following requirements for each method of application and plaster base indicated. Adjust mix proportions below within limits specified to attain workability.
- C. Fiber Content: Add fiber to following mixes after ingredients have mixed at least 2 minutes. Comply with fiber manufacturer's written instructions but do not exceed 1 lb/cu.fl of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.
- D. Two-Coat Work Over concrete unit masonry: $\frac{1}{2}$ " total thickness; base-coat proportions as indicated below:
 - 1. Base Coat: 1 part Portland cement, $\frac{3}{4}$ to 1- $\frac{1}{2}$ parts lime, 3 to 4 parts aggregate; $\frac{3}{8}$ " thickness.
- E. Job-Mixed Finish Coats: Proportion materials for finish coats in parts by volume for cementitious materials and parts by volume per sum of cementitious materials to comply with the following requirements:
 - 1. Proportions using sand aggregates as indicated below:
 - a. 1 part Portland cement, $\frac{3}{4}$ to 1- $\frac{1}{2}$ parts lime, 3 parts sand; $\frac{1}{8}$ " thickness.
- F. Stucco Finish Coat: (May be used in lieu of above described job mixed finish coat). Add water only; comply with stucco manufacturer's written instructions; $\frac{1}{8}$ " thickness.

2.6 MIXING

- A. Mechanically mix cementitious and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.

PART 3 - EXECUTION

3.1 PREPARATIONS FOR PLASTERING

- A. Clean plaster bases and substrates for direct application of plaster, removing loose material and substances that may impair the Work.
- B. Etch concrete surfaces indicated for direct plaster application. Scrub with acid-etching solution on previously wetted surface and rinse thoroughly with clean water. Repeat application, if necessary, to obtain adequate suction and mechanical bond of plaster.
- C. Apply bonding agent on concrete and concrete unit masonry surfaces indicated for direct plaster application; comply with manufacturer's written instructions for application.
- D. Install temporary grounds and screeds to ensure accurate rodding of plaster to true surfaces; coordinate with scratch-coat work.

3.2 INSTALLATION OF PLASTERING ACCESSORIES

- A. General: Comply with referenced lathing and furring installation standards for provision and location of plaster accessories of type indicated. Miter or cope accessories at corners; install with tight joints and in alignment. Attach accessories securely to plaster bases to hold accessories in place and in alignment during plastering. Install accessories of type indicated at following locations:
 - 1. External Corners: Install corner reinforcement at external corners.
 - 2. Terminations of Plaster: Install casing beads, unless otherwise indicated.
 - 3. Control Joints: Install at locations indicated or, if not indicated, at locations complying with the following criteria and approved by Architect:

- a. Where an expansion or contraction joint occurs in surface of construction directly behind plaster membrane.
- b. Distance between Control Joints: Not to exceed 18 feet in either direction or a length-to-width ratio of 2-1/2 to 1.
- c. Wall Areas: Not more than 144 sq. ft.
- d. Horizontal Surfaces: Not more than 100 sq. ft. in area.
- e. Where plaster panel sizes or dimensions change, extend joints full width or height of plaster membrane.

3.3 PLASTER APPLICATION

- A. Plaster Application Standard: Apply plaster materials, composition, and mixes to comply with ASTM C 926.
- B. Do not use materials that are caked, lumpy, dirty, or contaminated by foreign materials.
- C. Do not use excessive water in mixing and applying plaster materials.
- D. Flat Surface Tolerances: Do not deviate more than plus or minus 1/8 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed at any location on surface.
- E. Sequence plaster application with installation and protection of other work so that neither will be damaged by installation of other.
- F. Plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground, unless otherwise indicated. Where interior plaster is not terminated at metal frame by casing beads, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
- G. Corners: Make internal corners and angles square; finish external corners flush with cornerbeads on interior work, square and true with plaster faces on exterior work.
- H. Finish Coats: Apply finish coats to comply with the following requirements:
 - I. Float Finish: Apply finish coat to a minimum thickness of 1/8 inch to completely cover base coat, uniformly floated to a true even plane with "sand float" finish.
 - J. Prepared Finish: Apply factory-prepared finish coats according to manufacturer's written instructions.
- K. Moist-cure plaster base and finish coats to comply with ASTM C 926, including written instructions for time between coats and curing in "Annex A2 Design Considerations."

3.4 CUTTING AND PATCHING

- A. Cut, patch, replace, repair, and point up plaster as necessary to accommodate other work. Repair cracks and indented surfaces. Point-up finish plaster surfaces around items that are built into or penetrate plaster surfaces. Repair or replace work to eliminate blisters, buckles, check cracking, dry outs, efflorescence, excessive pinholes, and similar defects. Repair or replace work as necessary to comply with required visual effects.

3.5 CLEANING AND PROTECTING

- A. Remove temporary covering and other provisions made to minimize spattering of plaster on other work. Promptly remove plaster from door frames, windows, and other surfaces not to be plastered. Repair surfaces stained, marred or otherwise damaged during plastering work. When plastering work is completed, remove unused materials, containers, equipment, and plaster debris.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure plaster work is without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 09 2236 - METAL LATH

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Metal lath for portland cement plaster.
 - B. Access panels.
 - C. Cement Plaster Accessories.
- 1.2 RELATED REQUIREMENTS
 - A. Section 07 2500 - Weather Barriers: Water-resistive barrier under exterior plaster and stucco.
 - B. Section 08 3100 - Access Doors and Panels: Product requirements for metal access panels integral with metal lath.
 - C. Section 09 2116 - Gypsum Board Assemblies: Sheathing on exterior soffits.
- 1.3 REFERENCE STANDARDS
 - A. ASTM C847 - Standard Specification for Metal Lath.
 - B. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 - C. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - D. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
 - E. Portland Cement Association (PCA) - Stucco Installation Manual Portland Cement Plaster/Stucco Manual
- 1.4 PERFORMANCE REQUIREMENTS
 - A. Design and install framing and lath to limit deflection to the following:
 - 1. Maximum Deflection of Horizontal Assemblies: 1:240 deflection under dead loads and wind uplift.
- 1.5 SUBMITTALS
 - A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
 - B. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.
 - C. Submit details of all anticipated accessories to be installed.
- 1.6 QUALITY CONTROL
 - A. Maintain one copy of each installation standard referenced on site throughout the duration of lathing and plastering work.
 - B. Installer Qualifications: Company specializing in performing the work of this section a minimum five years documented experience.
 - C. A preinstallation conference is to be conducted on site to include the Constuction Manager, architect, subcontractor installing lath, accessories, portland cement plaster systems and masonry.
 - D. Contractor to contact representative of accessory manufacturer to visit site during installation and verify installation complies with manufacturer's requirements.
 - E. As part of the closeout documents the contractor is to submit a letter stating work is in accordance with manufacturer's product data and referenced standards.

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
 - A. Metal Lath and Accessories:
 - 1. Alabama Metal Industries Corporation: www.amico-lath.com.
 - 2. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.
- 2.2 FRAMING AND LATH ASSEMBLIES
 - A. Provide completed assemblies with the following characteristics:
 - 1. Maximum Deflection of Vertical Assemblies: 1:360 under lateral point load of 100 lbs.
 - 2. Maximum Deflection of Horizontal Assemblies: 1:240 deflection under dead loads and wind uplift.
- 2.3 LATH
 - A. Diamond Mesh Metal Lath: ASTM C847, galvanized; self-furring.
 - 1. Weight: To suit application, comply with deflection criteria, and as specified in ASTM C841 or ASTM C1063 for framing spacing.
 - 2. Weight: 3.4 lb/sq yd.
 - 3. Backed with treated paper.

- B. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, and maximum possible lengths.
 - 1. Material: PVC, open grid flanges or perforated.
 - 2. Casing Beads with Weep Holes: Square edges.
 - a. Thickness to accommodate plaster installation thickness.
 - 3. Corner Beads: Right angle corners.
 - 4. Base Screeds:
 - a. Products:
 - 5. Control Joints: Accordion profile with factory-installed protective tape, 2 inch flanges.
 - 6. Channel Screed: Use PVC with the same profile dimensions as DCS-626-75 manufactured by Fry Reglet.
 - 7. Reveal Molding: Use PVC with the same profile dimensions as PRM-75-75 manufactured by Fry Reglet.
- 2.4 BONDING AGENTS
 - A. Surface-applied bonding agents should conform to the requirements of ASTM C 932. Integral bonding agents should be used only after review of the manufacturer's documentation of testing and past performance
- 2.5 ACCESSORIES
 - A. Access Panels: See Section 08 3100.
 - B. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.
 - C. Fasteners: Self-piercing tapping screws; ASTM C1002 or ASTM C954.
 - D. Tie Wire: Annealed galvanized steel.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify existing conditions before starting work.
 - B. Verify that substrates are ready to receive work and conditions are suitable for application.
 - C. For exterior plaster and stucco on stud framed soffits, verify that weather barrier has been installed over sheathing substrate completely and correctly.
 - D. Do not begin until unacceptable conditions have been corrected.
 - E. If substrate preparation is the responsibility of another installer, notify Wilder Architecture, Inc. of unsatisfactory preparation before proceeding.
- 3.2 INSTALLATION - GENERAL
 - A. Install interior lath and furring for gypsum plaster in accordance with ASTM C841.
 - B. Install metal lath and furring for Portland cement plaster in accordance with ASTM C1063.
- 3.3 CONTROL JOINTS
 - A. Control Joint Spacing: 15 feet on center and as indicated on drawings.
 - 1. Install control joints per ASTM C1063.
 - a. Maintain a length to width ratio of 2.5 to 1.
 - b. Provide control joints to meet the ASTM standard. Coordinate additional control joints with Architect prior to installation.
 - B. Construct control joints of back-to-back casing beads set 1/4 inch apart. Set both beads over 6 inch wide strip of polyethylene sheet.
 - 1. Provide the polyethylene sheet where cement plaster is installed with metal plaster bases.
- 3.4 ACCESS PANELS INSTALLATION
 - A. Install access panels and rigidly secure in place.
 - B. Install frames plumb and level in opening. Secure rigidly in place.
 - C. Position to provide convenient access to concealed work requiring access.
- 3.5 LATH INSTALLATION
 - A. Apply lath taut, with long dimension perpendicular to supports.
 - B. Attach metal lath to metal supports using tie wire at maximum 6 inches on center.
 - C. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.
 - D. Place corner bead at external wall corners; fasten at outer edges of lath only.
 - E. Place base screeds at termination of plaster areas; secure rigidly in place.
 - F. Place 4 inch wide strips of lath centered over junctions of dissimilar backing materials, and secure rigidly in place.

- G. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.
- H. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.
- I. Install all accessories in accordance with manufacturer's product data and referenced standards.
- J. Provide elastomeric sealant at all joints, transitions, and terminations within plastering accessories to eliminate air and water migration within cement plaster applications.

3.6 TOLERANCES

- A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet.
- B. Maximum Variation from True Position: 1/8 inch.

END OF SECTION

SECTION 09 3100 - CERAMIC TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Porcelain paver tile.
 - 2. Unglazed ceramic mosaic tile.
 - 3. Glazed wall tile.
 - 4. Marble thresholds and window sills.
 - 5. Crack suppression membrane.
 - 6. Grout (epoxy).

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual tiles or sections of tile showing full range of colors, textures, and patterns available for each type and composition of tile indicated. Include samples of grout and accessories involving color selection.
- D. Samples for verification purposes of each item listed below, prepared on samples of size and construction indicated. Where products involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - 1. Each type and composition of tile and for each color and texture required, at least 12 inches square, mounted on plywood or hardboard backing and grouted.
 - 2. Full-size units of each type of trim and accessory for each color required.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- B. Single-Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.
- C. Installer Qualifications: Engage an experienced Installer who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

1.7 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials that match products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Porcelain Paver Tile:
 - a. Daltile "Continental Slate" - Basis of Design.
 - b. Stonepeak "Simply Modern"
 - c. Daltile "Affinity"
 - 2. Unglazed Ceramic Mosaic Tile:

- a. American Olean Tile Co., Inc.
- b. Dal-Tile Corp.
- c. United States Ceramic Tile Co.
- 3. Glazed Wall Tile:
 - a. American Olean Tile Co., Inc.
 - b. Dal-Tile Corp.
 - c. United States Ceramic Tile Co.
- 4. Latex-Emulsion-Based Latex-Portland Cement Mortars:
 - a. American Olean Tile Co., Inc.
 - b. Bonsal
 - c. Bostik Construction Products Div.
 - d. Custom Building Products
 - e. Laticrete International Inc.
 - f. Mapei Corp.
- 5. Commercial Portland Cement Grouts:
 - a. American Olean Tile Co., Inc.
 - b. Bonsal
 - c. Bostik Construction Products Div.
 - d. Custom Building Products
- 6. Acrylic Emulsions for Latex-Portland Cement Grouts:
 - a. American Olean Tile Co., Inc.
 - b. Bonsal
 - c. Bostik Construction Products Div.
 - d. Custom Building Products
 - e. Laticrete International Inc.
 - f. Mapei Corp.
- 7. Crack Suppression Membranes:
 - a. Schluter Systems L.P.
 - b. National Applied Construction Products, Inc.
 - c. Mapei
- 8. Grout Sealer:
 - a. Stone Tech Professional, Inc.
 - b. Aquamix
 - c. CeramaSeal
 - d. Mapei

2.2 PRODUCTS, GENERAL

- A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types, compositions, and grades of tile indicated.
 - 1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
- B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. Provide selections made by Architect from Manufacturer's standard color ranges as follows:
 - a. Porcelain Paver Tile: Any color in price groups 1 or 2.
 - b. Glazed Wall Tile: Any color in price groups 1 or 2 (no "accent" colors), similar to American Olean "Bright and Matte," and Dal-Tile "Semi-Gloss" and "Matte."
 - c. Unglazed Ceramic Mosaic Tile: Any color in price groups 1 or 2.
 - 2. Provide tile trim and accessories that match color and finish of adjoining flat tile.
- D. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory and package accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
- E. Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.

2.3 TILE PRODUCTS

- A. Porcelain Paver Tile: Provide flat tile complying with the following requirements:
 - 1. Composition: Porcelain.
 - 2. Nominal Facial Dimensions:
 - a. Floor Tile: 18 inches by 18 inches or 12 inches by 12 inches.
 - b. Restroom Wall - 10 inches by 14 inches or 12 inches by 12 inches.

- c. Shower Floors - 3 inches by 3 inches or 2 inches by 2 inches (mosaic).
 - 3. Nominal Thickness: 5/16 inch.
 - 4. Face: Plain with square edges
 - 5. Finish: Unpolished.
 - 6. Pattern: Stack Bond.
 - B. Glazed Wall Tile: Provide flat tile complying with the following requirements:
 - 1. Nominal Facial Dimensions:
 - a. Kitchen Backsplash and Mop Sink Tile Wall - 6 inches by 6 inches
 - 2. Nominal Thickness: 5/16 inch.
 - 3. Face: Plain with modified square edge or cushion edge.
 - 4. Mounting: Factory back-mounted.
 - C. Trim Units: Provide glazed wall tile trim units to match characteristics of adjoining flat tile and to comply with following requirements:
 - 1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
 - 2. Porcelain Paver Tile: Base to be 3" high by 12" long surface bullnose base.
- 2.4 STONE THRESHOLDS
- A. General: Provide stone that is uniform in color and finish, fabricated to sizes and profiles indicated or required to provide transition between tile surfaces and adjoining finished floor surfaces.
 - B. Marble Thresholds: Provide marble thresholds complying with ASTM C 503 requirements for exterior use and for abrasion resistance where exposed to foot traffic, a minimum hardness of 10 per ASTM C 241.
 - 1. Provide white, honed marble complying with MIA Group "A" requirements for soundness.
 - C. Window Sills: White marble, minimum 1/2" thick.
- 2.5 SETTING MATERIALS
- A. Thin Set Latex Portland Cement Mortar Installation Materials: Provide materials complying with ANSI A118.4 and as specified below.
 - 1. Mixture of Dry-Mortar Mix and Latex Additive: Factory-mixed formulation of mix and additive.
 - a. Portland Cement Mortar Installation Materials: Provide materials complying with ANSI A108.1A.
 - B. Wall Base Adhesive: Construction adhesive for securing tile base to gypsum board (except at showers) and casework base applications. Do not use thin set mortar for securing porcelain paver tile base to walls.
 - 1. Product: Liquid Nails Ceramic Wall and Floor Tile Adhesive.
- 2.6 GROUTING MATERIALS
- A. Epoxy Grout: color as a selected by Architect per installation plane, per room.
 - 1. ANSI A118.3.
 - 2. ANSI A108.
 - 3. ANSI A136.1.
 - 4. Manufacturer: Laticrete - Spectrlock Pro Premium (or equal).
- 2.7 CRACK SUPPRESSION MEMBRANE
- A. Flexible "Peel-and-Stick Sheet: Provide a highly flexible elastomeric, self-bonding, pressure- sensitive sheet membrane system for crack isolation that is compatible with latex-modified thin set mortars. Provide one of the following:
 - 1. Mapelastic SM, Mapei
 - 2. ECB Membrane, National Applied Construction Products, Inc.
 - 3. Schluter - KERD1, Schluter Systems
- 2.8 GROUT SEALER
- A. Grout Sealer: Water-based liquid sealer that resists water, oil, and acid-based contaminants. Provide one of the following:
 - 1. All Purpose Grout Sealer, StoneTech Professional, Inc.
 - 2. Grout & Tile Sealer, CeramaSeal
 - 3. Keraseal Tile and Grout Sealer, Mapei
 - 4. Grout Sealer, Aqua Mix
- 2.9 GROUT RELEASE
- A. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 - 1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile. Provide one of the following:
 - a. "Grout Release," Aqua Mix.
 - b. "SL-90 Summit Shield Grout Release," Summitville.
 - c. "Grout Easy," Aldon.

d. "Super Grout Release," Klein and Company, Inc.

2.10 WATERPROOFING FOR TILE SHOWER RECEPTORS

- A. Polyethylene Sheet Waterproofing: Manufacturer's standard proprietary product consisting of composite sheets, 60 inches wide by a nominal thickness of 0.040 inches, composed of an inner layer of chlorinated polyethylene sheet faced on both sides with laminated high-strength nonwoven polyester material designed for embedding in latex- Portland cement mortar, and as the substrate for latex-Portland cement mortar setting bed.
- B. PVC-Sheet Waterproofing: Manufacturer's standard proprietary product consisting of composite sheets, 60 inches of PVC sheet heat-fused together and to facings of bendable nonwoven polyester, designed for embedding in latex-Portland cement mortar and as the substrate for latex-Portland cement mortar setting bed.
- C. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Polyethylene Sheet Waterproofing:
 - a. "Chloraloy"; Noble Co.
 - 2. PVC Sheet Waterproofing:
 - a. "Composeal Blue"; Compotite Corp.

2.11 MISCELLANEOUS MATERIALS

- A. Temporary Protective Coating for Porcelain Paver Tile: Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; is compatible with tile, mortar, and grout products; and is easily removable after grouting is completed without damaging grout or tile.
 - 1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as a temporary protective coating for tile.

2.12 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile" that apply to type of setting and grouting materials and methods indicated.
- B. TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.
 - 1. Porcelain paver wall base shall be mitered at inside and outside corners. Ease cut edges at miters.
- E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise shown.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.
 - F. Expansion Joints: Locate expansion joints as noted on architectural and/or structural drawings and field verify.
 1. Provide sealant-filled joints in tile directly above expansion joints in slabs. Use 1 or 2 part pourable polyurethane sealant for Use T in color selected by architect. Follow Tile Council of America Handbook for Ceramic Tile Installation details.
 2. Tile expansion joints are not required at concrete slab control joints which are to receive crack suppression membrane.
 - G. Grout tile to comply with the requirements of the following installation standards:
 1. Provide epoxy grout.
- 3.4 FLOOR INSTALLATION METHODS
- A. Ceramic Mosaic Tile at Shower Receptors: Install tile to comply with requirements indicated below for setting bed methods, TCA installation methods related to types of subfloor construction, and grout types:
 1. Bond Coat: Portland cement paste or dust coat on plastic bed or the following thin-set mortar on cured bed, ANSI A108.5 at Contractor's option:
 - a. Latex - Portland Cement Mortar.
 2. Grout: Dry-set sanded grout with latex additive: Installation Specification - ANSI A108.10.
 3. TCA Installation Method 8420 for glass mat tile backer board.
 - B. Porcelain Paver Tile for Thin Set Installation Over Concrete Slabs: Install tile to comply with requirements indicated below for setting bed methods, TCA installation method and grout types:
 1. Latex - Portland Cement Mortar: Installation Specification - ANSI A108.5.
 2. Grout: Dry-set sanded grout with latex additive: Installation specification - ANSI A108.10.
 3. TCA Installation Method f 113.
- 3.5 WALL TILE INSTALLATION METHODS
- A. Install types of tile designated for wall application to comply with requirements indicated below for setting-bed methods, TCA installation methods related to subsurface wall conditions, and grout types:
 1. Thin-set latex-Portland Cement Mortar: Installation Specification-ANSI A108.5.
 2. Grout: Dry-set, non-sanded with latex additive: Installation Specification-ANSI A108.10.
 3. TCA Installation Method 8420 for glass mat tile backer board. Install sanitary cove base flush with floor tile - do not set base on top of floor tile.
 4. Secure porcelain paver tile base to drywall partitions using construction adhesive applied in accordance with manufacturer's instructions using V-type trowel with notches 3/16" deep.
- 3.6 CLEANING AND PROTECTION
- A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove latex-Portland cement grout residue from tile as soon as possible.
 2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
 3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer.
 - B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.
 - C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensure that tile is without damage or deterioration at time of Substantial Completion.
 1. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
 2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
 - D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION

SECTION 09 5110 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 SUMMARY
 - A. This Section includes ceilings composed of acoustical panels and exposed suspension systems.
- 1.3 SUBMITTALS
 - A. General: Submit each item in this Article according to the Conditions of the Contract.
 - B. Product data for each type of product specified.
 - C. Samples for initial selection in the form of manufacturer's color charts consisting of actual acoustical panels or sections of panels and sections of suspension system members showing the full range of colors, textures, and patterns available for each ceiling assembly indicated.
 - D. Samples for verification of each type of exposed finish required, prepared on samples of size indicated below. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - 1. 6-inch square samples of each acoustical panel type, pattern, and color.
 - 2. Set of 12-inch long samples of exposed suspension system members, including moldings, for each color and system type required.
 - E. Product test reports from a qualified independent testing agency that are based on its testing of current products for compliance of acoustical panel ceilings and components with requirements.
- 1.4 QUALITY ASSURANCE
 - A. Installer Qualifications: Engage an experienced Installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
 - B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
 - C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.
- 1.6 PROJECT CONDITIONS
 - A. Space Enclosure and Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is completed and dry, work above ceilings is complete, and ambient temperature and humidity conditions are being maintained at the levels required by manufacturer(s) to eliminate sagging or curling of ceiling panels.
- 1.7 COORDINATION
 - A. Coordinate layout and installation of acoustical panels and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components (if any), and partition assemblies (if any).
- 1.8 EXTRA MATERIALS
 - A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.
 - 1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

- 2.1 ACOUSTICAL CEILING UNITS, GENERAL:
 - A. Standard for Acoustical Ceiling Units: Provide manufacturer's standard units of configuration indicated that comply with ASTM E 1264 classifications as designated by reference to types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - 1. Mounting Method for Measuring NCR: Type E-400 (plenum mounting in which face of test specimen is 15-3/4 inches away from the test surface) per ASTM RE 795.
 - B. Colors and Patterns: Provide products to match appearance characteristics indicated under each product type.

2.2 HIGH HUMIDITY RESISTANT ACOUSTICAL PANELS

- A. Description: Provide Type III, Form 2, Pattern CD units per ASTM E 1264 with painted finish; and as follows:
 - 1. Performance Criteria: LR 0.82; NRC 0.55-.65; CAC 35-39.
 - 2. Edge Detail: angled tegular. Install in wide-face suspension system.
 - 3. Size: 24 inches by 24 inches by 3/4 inch, typical.
 - 4. Color: White.
 - 5. Panels are scheduled as "APC-1" on drawings.
- B. Product: Subject to compliance with requirements, provide one of the following:
 - 1. Armstrong Cirrus (24" x 24" x 3/4") [basis of design]
 - 2. humigard plus

2.3 CERAMIC AND MINERAL FIBER COMPOSITE PANELS

- A. Description: Provide high density, ceramic-base panels classified as noncombustible by the NFPA, flame spread: 0; smoke developed: 0.
 - 1. Performance Criteria: LR 0.80; NRC 0.45-0.55; CAC 40-44.
 - 2. Edge Detail: angled tegular.
 - 3. Size: 24 inches by 24 inches by 3/4 inch.
 - 4. Color: White.
 - 5. Panels are scheduled as "APC-2" on drawings.
 - 6. Provide panel from same vendor, edge detail, and texture as APC-1

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.
 - 1. 15"/16" suspension system.
- B. Finishes and Colors: Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated Carbon Steel Wire: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so that its stress at 3 times the hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than the yield stress of wire, but provide not less than 0.106-inch diameter (12 gage) wire.
- E. Sheet-Metal Edge Moldings and Trim: Type and profile indicated, or if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.

2.5 NON-FIRE-RESISTANCE-RATED, DIRECT-HUNG SUSPENSION SYSTEMS

- A. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from hot dipped galvanized, cold-rolled steel sheet, with prefinished 15/16-inch wide metal caps on flanges; other characteristics as follows:
 - 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) type.
 - 3. Cap Material and Finish: Hot dipped galvanized steel sheet painted white.
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Standard Grid (for APC-1 and APC-2).
 - 2. Prelude 15/16" Exposed Tee System"; Armstrong World Industries.
 - 3. Series 200 - "H" Hot Dipped; Chicago Metallic.
 - 4. "Donn DX"; Donn/USG Interiors, Inc., flat white #050.
- C. Warranty: Manufacturer's standard limited 10-year warranty against rusting of grid.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
 - 1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

- B. Measure each ceiling area and establish the layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and conform to the layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's instructions and C/SCA "Ceiling Systems Handbook."
 - 1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of the supporting structure or of the ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of 3 tight turns. Connect hangers either directly to structures or to inserts, eye screws, or other devices that are secure, that are appropriate for substrate, and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 6. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise shown; and provide hangers not more than 8 inches from ends of each member.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Screw attach moldings to substrate at intervals not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide neat, precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - 2. Install panels with pattern running in one direction parallel to long axis of space.
- F. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
- G. Install sprinkler heads centered in ceiling tile.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 6566 - RESILIENT ATHLETIC FLOORING

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Rubber sheet flooring, adhesively installed.
- 1.2 RELATED REQUIREMENTS
 - A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.
- 1.3 REFERENCE STANDARDS
 - A. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness.
 - B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 - C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - D. CHPS (HPPD) - High Performance Products Database.
- 1.4 SUBMITTALS
 - A. Product Data: Manufacturer's printed data sheets for products specified.
 - B. Selection Samples: Manufacturer's color charts for flooring materials specified and game line paints, indicating full range of colors and textures available.
 - C. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- 1.5 QUALITY ASSURANCE
 - A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
 - B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver materials to project site in unopened containers clearly labeled with manufacturer's name and identification of contents.
 - B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent marring and soiling of finished surfaces.
- 1.7 FIELD CONDITIONS
 - A. Maintain temperature in spaces to receive adhesively installed resilient flooring within range of 70 to 95 degrees F for not less than 48 hours before the beginning of installation and for not less than 48 hours after installation has been completed. Subsequently, do not allow temperature in installed spaces to drop below 50 degrees F or to go above 100 degrees F.

PART 2 PRODUCTS

- 2.1 PREFORMED ATHLETIC FLOORING
 - A. Rubber Sheet Flooring: Two-layer vulcanized rubber.
 - 1. Thickness: Minimum 0.256 inch, nominal.
 - 2. Surface Texture: Embossed.
 - 3. Color: To be selected from Manufacturer's full range of colors..
 - 4. Products:
 - a. ShawContract - Rexcourt.
- 2.2 ACCESSORIES
 - A. Leveling Compound: Latex-modified cement formulation as recommended by flooring manufacturer for substrate conditions.
 - B. Flooring Adhesive: Waterproof; types recommended by flooring manufacturer.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Examine substrates for conditions detrimental to installation of athletic flooring. Proceed with installation only after unsatisfactory conditions have been corrected.
 - B. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of athletic flooring to substrate.

- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.2 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Concrete: Use leveling compound as necessary to achieve substrate flatness of plus or minus 1/8 inch within 10 ft radius.
- C. Remove coatings that are incompatible with flooring adhesives, using methods recommended by flooring manufacturer.
- D. Broom clean areas to receive athletic flooring immediately before beginning installation.

3.3 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Resilient Sheet Flooring:
 - 1. Unroll flooring and allow to relax before beginning installation.
 - 2. Mix adhesive thoroughly and apply to substrate with notched trowel. Roll flooring into fresh adhesive, overlapping end seams and double cutting, butting factory edges and compression fitting.
 - 3. Roll entire flooring surface with steel roller to assure adhesion to substrate and eliminate air bubbles.
 - 4. Immediately remove any adhesive from flooring surface, using chemical recommended by flooring manufacturer.
 - 5. Weld seams using techniques and equipment recommended by manufacturer.
 - 6. Lay out game lines using tape and taping machine approved by flooring manufacturer. Apply game line paint with roller, and allow to dry before removing tape.
 - 7. Apply transparent top coat over flooring if recommended by manufacturer, to achieve a uniform finished appearance.

3.4 CLEANING

- A. Clean flooring using methods recommended by manufacturer.

3.5 PROTECTION

- A. Protect finished athletic flooring from construction traffic to ensure that it is without damage upon Date of Substantial Completion.

END OF SECTION

SECTION 09 9120 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color or finish is not indicated, Architect will select from standard colors and finishes available.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Acoustical Wall Panels.
 - c. Metal lockers.
 - d. Elevator entrance doors and frames.
 - e. Elevator equipment.
 - f. Finished mechanical and electrical equipment.
 - g. Light fixtures.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Furred areas.
 - b. Ceiling plenums.
 - c. Pipe spaces.
 - d. Duct shafts.
 - e. Elevator shafts.
 - f. Attic spaces.
 - 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 - 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.2 REFERENCED STANDARDS

- A. The referenced standards listed below are considered part of the requirements listed in this section. If specific aspects of the standards do not apply, the Contractor shall identify the specific references in writing prior to beginning work. All requests for omission must be approved by the Architect.
 - 1. ASTM International (ASTM)
 - a. ASTM A 123 Hot-Dip Galvanized Coatings on Iron and Steel Products;
 - b. ASTM A 780 - Repair of Hot Dip Galvanized Coatings;
 - c. ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications;
 - d. ASTM D 653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process;
 - e. ASTM D 6386 - Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting;
 - f. ASTM D 2092 Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting;
 - g. ASTM D 4258 Surface Cleaning Concrete for Coating;
 - h. ASTM D 4261 Surface Cleaning Concrete Unit Masonry for Coating;
 - i. ASTM D 4259 Abrading Concrete;
 - j. ASTM F 1869 Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride;
 - k. ASTM D 4414 Standard Practice for Measurement of Wet Film Thickness (WFT) by Notch Gages;
 - l. ASTM D 5064 Practice for Conducting a Patch Test to Assess Coating Compatibility;
 - m. ASTM D 3276 Standard Guide for Painting Inspectors (Metal Substrates);
 - n. ASTM D 3359 Adhesion by Tape Test

- o. ASTM D 4261 Surface Cleaning Concrete Unit Masonry for Coating;
- p. ASTM D 4414 Standard Practice for Measurement of Wet Film Thickness (WFT) by Notch Gages;
- 2. Society for Protective Coatings (SSPC)
 - a. SSPC-PA 1 Shop, Field, and Maintenance Painting of Steel;
 - b. SSPC-PA 2 Measurement of Dry Coating Thickness with Magnetic Gauges;
 - c. SSPC-SP 2 Hand Tool Cleaning;
 - d. SSPC-SP 3 Power Tool Cleaning;
 - e. SSPC Guide 6 Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations;
- 3. High Performance Building Reference Standards:
 - a. CAL (VOC) - Standard Practice for the Testing of Volatile Organic Emissions From Various Sources Using Small-Scale Environmental Chambers (including Addendum 2004-01); State of California Department of Health Services.
 - b. Refer to Specification Section 01616 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 DEFINITIONS

- A. Terminology as defined in the following standards apply to this section:
 - 1. ASTM D 16 Paint, Related Coatings, Materials, and Applications;
 - 2. ASTM E 284 Appearance;
 - 3. ASTM C 11 Standard Terminology Relating to Gypsum and Related Building Materials and Systems;
 - 4. National Paint & Coatings Association (NPCA) Glossary of Terms as listed at the following URL:
www.paint.org/ind_info/terms.cfm;
 - 5. Paint/Coatings Dictionary, © 1978 by Federation of Societies for Coatings Technology.
- B. Design Standard: The paint/coating material specifically referenced by manufacturer's name/number, which determines the performance and quality requirements for materials referred in this Section.
- C. Low VOC Alternative: Where a primer or paint is scheduled for use on the interior of the building a product that meets (does not exceed) the VOC content limits established in the Project Manual shall be used. The supplier shall review all primers and paints submitted and provide appropriate alternative, comparable submittal to ensure that all primers (anti-corrosive, anti-rust, and otherwise), paints, varnishes, stains, shellacs, and coatings meet the criteria established in the Project Manual for Volatile Organic Compounds (VOCs), see Section 01616 - Volatile Organic Compound (VOC) Content Restrictions.
 - 1. Interior of the building is inside the weatherproofing system(s).

1.4 SUBMITTALS

- A. Complete and submit the Paint Material Cross Reference List for all paint/coating materials submitted (excluding the Design Standard).
- B. Complete and submit the Label Analysis Form for all paint/coating materials submitted (excluding the Design Standard).
- C. Environmental Health and Safety Plan (relating to disturbance of paint with hazardous constituents);
- D. Containment System Plan.
- E. Waste Collection, Handling, Disposal Plan.
- F. Manufacturer's Information: Manufacturer's technical information including instructions for handling, storing, surface preparation application, warranty etc.
- G. Samples for Initial Selection: For each type of finish-coat material indicated provide a full color palette. After color selection, Architect will furnish a schedule indicating surfaces for each color selected.
- H. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
 - 1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall Surfaces: Provide samples on at least one wall.
 - b. Small Areas and Items: Architect will designate items or areas required.
 - 2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
 - b. Final approval of colors will be from benchmark samples.
- I. Errors, Omissions, and Other Discrepancies
 - 1. Submit all errors, omissions, and other discrepancies in contract documents to the Architect within 30 days of contract award for all work covered in this Section, other than the work that will not be uncovered until a later date. All such discrepancies shall be addressed and resolved, and the work plan modified, prior to beginning the initial and follow-up phases of work. Discrepancies that become

apparent only after work is uncovered shall be identified at the earliest discoverable time and submitted for resolution.

1.5 QUALITY CONTROL

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. The Contractor should provide evidence to the Owner, with the bid submittal, that the Contractor, performing these coating operations is currently certified SSPC QP-1 by SSPC, The Society for Protective Coatings. Such certification is to remain in effect through the life of the contract.
- C. The Contractor shall designate a specific individual as the Paint/Coating Quality Control Supervisor (QCS). The QCS shall perform testing to ensure conformance to all requirements outlined in this section.
 - 1. QCS or designated personnel performing Quality Control (QC) testing during steel surface preparation and painting shall be NACE Level 1 Certified.
- D. During steel surface preparation and painting, Daily Inspection Reports shall be prepared in accordance with ASTM D 3276.

1.6 WARRANTY

- A. Manufacturer shall provide a minimum 5 year material and labor warranty covering defective materials for all finish systems. If a specific finish system has a standard warranty greater than the 5 year warranty indicated the greater warranty shall apply.
- B. Installer Warranty: two years from date of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.8 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- C. Do not apply paint in rain, fog, or to damp or wet surfaces.
- D. Do not apply when the air or surface is excessively hot resulting in "mud cracking." If mud cracking occurs an additional coat will be required. Mud cracking is not considered an acceptable condition.
- E. Do not apply paint when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The Design Standard paint/coating materials for this Section is The Sherwin Williams Company (SW). Subject to compliance with product submittal/approval requirements, provide one of the products listed in this Section or an equivalent product, as determined by the Architect. Other manufacturers will be considered contingent upon their responsiveness to the requirements set forth in Section

2.2 MATERIALS (GENERAL)

- A. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- B. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- C. Colors: As selected by Architect from manufacturer's full range.

1. Approval of the in-place color against approved color chips shall be solely the right and judgment of the Architect.
2. Each underlying coat shall be tinted lighter than next coat or finish coat. The contrast shall be visible at a distance not less than 10 feet. The degree of contrast can be modified at the discretion of the Architect or appointed designee.

2.3 PRIMERS

- A. Exterior Painted Portland-Cement Plaster, Finished and/or Painted Concrete:
 1. SW Loxon Conditioner A24W100 (Guide Coat White).
- B. Exterior Traffic Coating:
 1. SW Tread-Plex Primer.
- C. Ferrous-Metal Door and Frame Primer:
 1. SW Kem Kromik Universal Metal Primer B50NZ6/B50WZ1.
- D. Hot-dip Galvanized Metal:
 1. SW Pro-Cryl Universal Primer B66-310
- E. Interior Gypsum Wall Board (GWB) with textured and smooth finish (water-based finishes):
 1. SW PrepRite 200 Latex Wall Primer B28W200 Series

2.4 FINISH COATS

- A. Exterior, High-build Acrylic Paint (Flat finish):
 1. SW Loxon Acrylic Coating A24W300
- B. Exterior Alkyd Gloss Enamel :
 1. SW Industrial Enamel HS B54Z-400.
- C. Interior Alkyd Semi-gloss Enamel:
 1. SW ProMar 200 Interior Alkyd Semi-Gloss B34W200.
- D. Interior Semi-Gloss Water-Based Epoxy:
 1. SW Water-based Catalyzed Epoxy B70 (with Semi-Gloss Hardener B60V25)
- E. Interior Semi-Gloss
 1. SW ProMar 200 Interior Latex Semi-Gloss B31W2200.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 TECHNICAL REPRESENTATION BY PAINT MANUFACTURER

- A. A qualified technical representative of the paint manufacturers shall periodically visit the site to verify that the quality of surface preparation and painting conform to their requirements. Visits are required at the start of the project and a minimum of two visits during each of the following phases:
 1. Mockup review;
 2. Surface preparation;
 3. Primer application; and,
 4. Finish coat application.
- B. The manufacturer's representative shall summarize the results of the inspections in writing and provide recommendations if necessary. The Contractor shall provide copies of the manufacturer's reports to the Owner within seven days after each site visits.
- C. The Contractor shall comply with all manufacturers recommendations presented within the report at no additional cost to the Owner.

3.3 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning:
 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
 2. Solvent Cleaning: Solvent Cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants. Solvent cleaning does drawing and cutting compounds, and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Allow adequate ventilation. Refer to Steel Structures Paint Council Surface Preparation Specification No.1 (SSPC-SP1).
 3. Water Blasting NACE Standard RP-01-72: Removal of oil, grease, dirt, loose rust, loose mill scale, and loose paint by water pressures of 2,000 to 2,5000 psi at a flow of 4 to 14 gallons per minute.
 4. Hand Tool Cleaning: Hand tool cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they can not be removed by lifting with a dull putty knife. Before hand tool cleaning, remove visible oil, grease, soluble residues, and salts by the methods outlined in SSPC-SP1. For complete instructions refer to Steel Structures Paint Council Surface Preparation Specification No.2.
- C. Surface Preparation:
 1. Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings in accordance with manufacturer's written instructions for each particular substrate condition and as specified.
 2. Provide barrier coats over incompatible primers or remove and reprime. Typical incompatibility involves epoxy primers that have cured beyond their maximum recoat time.
 3. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents from concrete and/or cementitious materials. If chemical compounds have been used to expedite curing, use mechanical methods of surface preparation to enable water to penetrate. Perform water mist testing of new concrete to determine the presence of curing compounds.
 4. Previously Painted Stucco: The amount of time between pressure cleaning and primer application shall not exceed four (4) days or re-cleaning will be required.
 5. If dirt splash along base of a cleaned surface occurs, removal shall be performed via pressure cleaning or scrub brush and water. Dry broom removal is not an acceptable method of cleaning.
 6. Determine alkalinity and moisture content of concrete surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 7. Previously Coated Surfaces: Maintenance painting will frequently not permit or require the removal of all old coatings prior to repainting. However, all surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers must be removed to assure sound bonding to the tightly adhering old paint. Glossy surfaces of old paint films must be clean and dull before repainting. Thorough washing with an abrasive cleanser will clean and dull in one operation, or wash thoroughly and dull by sanding. Spot prime any bare areas with an appropriate primer. Check for compatibility by applying a test patch of the recommended coating system, covering at least 2 to 3 square feet. Allow to dry one week before testing adhesion per ASTM D3359. If the coating system is incompatible, complete removal is required.
 8. Ferrous metal that has not been hot-dip galvanized or shop-primed shall be cleaned as follows:
 - a. Clean in accordance with SSPC SP 1 Solvent Cleaning
 - b. Blast steel surfaces in accordance with SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning.
 - c. Primer shall be applied within four hours of abrasive blasting or as soon as practicable after structural engineer's inspection.
 - 1) Coordinate abrasive blasting with structural engineer. Engineer shall inspect raw metal prior to application of primer to determine if additional steel replacements are needed.
 9. Shop-primed ferrous metal (hollow metal doorframes and metal doors) shall be inspected for damage to the shop-applied primer and cleaned/touched-up as follows:
 - a. Clean in accordance with SSPC SP 1 Solvent Cleaning;
 - b. Sand damaged areas to smooth the edges of the damaged surface;
 - c. Touch-up with field primer immediately after cleaning and sanding.
 - d. Existing metal to remain shall be prepared to create a 'like new' finished appearance.
 10. Existing ferrous metal (hollow metal door frames and metal doors) shall be inspected for adhesion integrity prior to application of the new paint system. The following testing shall be performed on each existing doorframe and door prior to painting:

- a. Measure existing dry film thickness (DFT) testing. If existing thickness exceeds 20 mils the coating system shall be chemically removed (to bare steel or galvanized layer).
 - b. Perform two adhesion tests (ASTM D 3359) per side of door; rating shall be a minimum of 3A. If rating of 2A or less is found, the poorly adhered paint shall be removed and the exposed paint edges feather sanded prior to primer application;
 - c. Perform three adhesion tests (ASTM D 3359) per door frame; rating shall be a minimum of 3A. If rating of 2A or less is found, the poorly adhered paint shall be removed and the exposed paint edges feather sanded prior to primer application;
 - d. Existing metal to remain shall be prepared to create a 'like new' finished appearance.
11. Hot-dip Galvanized (HDG) Steel:
- a. Clean galvanized surfaces using a degreasing solution (e.g. Simple Green).
 - b. If chromate pretreatment is present, remove by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
- 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.4 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
- 1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 3. Provide finish coats that are compatible with primers used.
 - 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
 - 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 - 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 - 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 - 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 - 10. Sand lightly between each succeeding enamel coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
- 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 - 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
- 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
 - 1. Uninsulated metal piping.
 - 2. Pipe hangers and supports.
 - 3. Tanks that do not have factory-applied final finishes.
 - 4. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - 5. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 - 6. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- G. Electrical items to be painted include, but are not limited to, the following:
 - 1. Switchgear.
 - 2. Panelboards.
 - 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.5 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
 - 1. Construction Manager will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Subcontractor.
 - 2. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.6 EXTERIOR PAINT SCHEDULE

- A. Exterior Concrete Masonry Units (smooth), Vertical Stucco Surfaces at conditioned spaces:
 - 1. Primer: SW Loxon Block Surfacers A24W200; apply at WFT range of 16.0 mils to achieve a minimum of 8.0 mils.
 - 2. Patching: Voids in mortar joints and/or CMU shall be filled with a lightweight spackle compound and tooled to match the surrounding texture.
 - 3. Intermediate Coat: SW Acrylic Coating A24W300; apply at WFT range of 8.0 - 10.0 mils to achieve DFT range of 3.6 - 4.5 mils. Tint 50-percent of finish coat to create definable contrast.
 - 4. Finish Coat: SW Acrylic Coating A24W300; apply at WFT range of 8.0 - 10.0 mils to achieve DFT range of 3.6 - 4.5 mils per coat.
- B. Exterior Stucco Soffits:
 - 1. Primer: SW Loxon Exterior Masonry Acrylic Primer A24W300; apply at WFT range of Coverage rate shall not exceed 300 square feet per gallon.
 - 2. Finish Coat: SW Loxon Acrylic Coating A24W300; apply at WFT range of 8.0 - 10.0 mils to achieve DFT range of 3.6 - 4.5 mils per coat.
- C. Ferrous Metal Doors and Frames:
 - 1. Primer: SW Kem Kromik Universal Metal Primer B50NZ6/B50WZ1; apply at a dry film thickness of not less than 3.0 mils.
 - 2. Finish Coat: SW Industrial Enamel HS B54Z-400; apply at WFT range of 3.5 - 7.0 mils to achieve DFT range of 2.0 - 4.0 mils. If one coat does not completely cover the primer, apply additional coat.
 - a. Note: Primer and Finish Coat shall have a definable contrast between the two colors.
- D. HDG Steel:
 - 1. Primer: SW Pro-Cryl Universal Primer B66-310; apply at WFT range of 5.0 - 10.0 mils to achieve DFT range of 2.0 - 4.0 mils.

2. Finish Coat: SW Industrial Enamel HS B54Z-400; apply at WFT range of 3.5 - 7.0 mils to achieve DFT range of 2.0 - 4.0 mils. If one coat does not completely cover the primer, apply additional coat.
 - a. Note: Primer and Finish Coat shall have a definable contrast between the two colors.

3.7 INTERIOR PAINT SCHEDULE

- A. Concrete Masonry Units (smooth-faced) and brick masonry substrates at conditioned and unconditioned spaces:
 1. Primer: SW Loxon Block Surfacers A24W200; apply at WFT range of 16.0 mils to achieve a minimum of 8.0 mils.
 2. Patching: Voids in mortar joints and/or CMU shall be filled with a lightweight spackle compound and tooled to match the surrounding texture.
 3. Intermediate Coat: SW ProMar 200 Interior Latex Semi-Gloss B31W2200; apply at WFT range of 4.0 - 5.0 mils to achieve DFT range of 1.5 - 2.0 mils. Tint 50-percent of finish coat to create definable contrast.
 4. Finish Coat: SW ProMar 200 Interior Latex Semi-Gloss B31W2200; apply at WFT range of 4.0 - 5.0 mils to achieve DFT range of 1.5 - 2.0 mils.
- B. Sealed Concrete Floor:
 1. Primer: ArmorSeal Water Based Epoxy Primer Clear; one coat, apply at DFT of 2.0 - 3.0 mils.
 2. Finish Coat: ArmorSeal 700 HS Water Based Epoxy Floor Coating; one coat, apply at DFT of 6.5 - 7.5 mils.
 3. At Apparatus Bay provide Vulkem 351 (Basis of Design) for areas in the plan shown to receive Epoxy Flooring (Non-Walking Surfaces).
- C. Gypsum Wallboard:
 1. Primer: SW PrepRite 200 Interior Latex Primer B28W200; apply at WFT range of 4.0 - 5.0 mils to achieve DFT range of 1.5 - 2.0 mils.
 2. Intermediate Coat: SW ProMar 200 Interior Latex Semi-Gloss B31W2200; apply at WFT range of 4.0 - 5.0 mils to achieve DFT range of 1.5 - 2.0 mils. Tint 50-percent of finish coat to create definable contrast.
 3. Finish Coat: SW ProMar 200 Interior Latex Semi-Gloss B31W2200; apply at WFT range of 4.0 - 5.0 mils to achieve DFT range of 1.5 - 2.0 mils.
- D. Gypsum Wallboard (Epoxy Coating):
 1. Primer: SW PrepRite 200 Interior Latex Primer B28W200; apply at WFT range of 4.0 - 5.0 mils to achieve DFT range of 1.5 - 2.0 mils.
 2. Intermediate Coat: SW Water Based Catalyzed Epoxy (semi-gloss); apply at WFT range of 6.0 - 8.0 mils to achieve DFT range of 2.5 - 3.0 mils. Tint 50-percent of finish coat to create definable contrast.
 3. Finish Coat: SW Water Based Catalyzed Epoxy (semi-gloss); apply at WFT range of 6.0 - 8.0 mils to achieve DFT range of 2.5 - 3.0 mils.
 4. Provide at all gypsum wallboard surfaces in Toilet Rooms.
- E. Ferrous Metal Doors and Frames:
 1. Primer: SW Kem Kromik Universal Metal Primer B50NZ6/B50WZ1; apply at a dry film thickness of not less than 3.0 mils.
 2. Finish Coat: SW Industrial Enamel HS B54Z-400; apply at WFT range of 3.5 - 7.0 mils to achieve DFT range of 2.0 - 4.0 mils. If one coat does not completely cover the primer, apply additional coat.
 - a. Note: Primer and Finish Coat shall have a definable contrast between the two colors.
- F. HDG Steel: Provide the following finish systems over exterior zinc-coated metal surfaces:
 1. Primer: SW Pro-Cryl Universal Primer B66-310; apply at WFT range of 5.0 - 10.0 mils to achieve DFT range of 2.0 - 4.0 mils.
 2. Finish Coat: SW Industrial Enamel HS B54Z-400; apply at WFT range of 3.5 - 7.0 mils to achieve DFT range of 2.0 - 4.0 mils. If one coat does not completely cover the primer, apply additional coat.
 - a. Note: Primer and Finish Coat shall have a definable contrast between the two colors.
- G. Exterior Aluminum:
 1. Preparation: Acid Etch with Porter - 33 Aluma Prep.
 2. Prime Coat: Porter - 215 Rust Screen Acrylic Metal Primer.
 3. Finish Coat: Porter -739 Acrylic-shield statin Exterior Acrylic Paint.

3.8 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.9 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

PAINT MATERIAL CROSS REFERENCE LIST

PROVIDE A LABEL ANALYSIS AS SHOWN IN THE EXAMPLE BELOW. THIS LIST IS REQUIRED AS PART OF THE SUBMITTALS.

SPEC SECTION	GENERIC DESCRIPTION	PRODUCT NAME	PRODUCT NO.	SUBSTRATE(S)	LOCATION(S)
2.4,H, 1 (E.G.)	WATER BASED EPOXY (E.G.)	HI-BILD WATER-BAS ED CATALYZED EPOXY (E.G)	B71-V10 0 (E.G.)	DRYWALL (FINISH), CMU, CAST-IN-PLACE (C.I.P) CONCRETE (E.G.)	BATHROOM INTERIOR WALLS (E.G.)

CONTINUE ROWS AS REQUIRED BY THE SUBMITTAL.

LABEL ANALYSIS FORM

PROVIDE A LABEL ANALYSIS AS SHOWN IN THE EXAMPLE BELOW. THIS LIST IS REQUIRED AS PART OF THE SUBMITTALS WHEN THE DESIGN STANDARD IS NOT PROVIDED. PROVIDE THE FOLLOWING DATA:

PRODUCT NAME:	PRODUCT NUMBER:	MANUFACTURER:

COMPOSITION BY WEIGHT:

WEIGHT PER GALLON:	LBS.	P.V.C.	%
SOLIDS BY WEIGHT:	%	SOLIDS BY VOLUME:	%
TOTAL PIGMENT:	%	TOTAL VEHICLE:	%

LIST COMPONENTS COMPRISING PIGMENT. QUANTIFY COMPONENTS NO PROVIDED (I.E. EXTENDER PIGMENTS, ANTI-CORROSIVES, ETC.).	LIST COMPONENTS COMPRISING VEHICLE. QUANTIFY COMPONENTS NO PROVIDED (I.E. ADDITIVES, FUNGICIDE, BIOCID, ETC.).

TITANIUM OXIDE (TIO2)	%	ACRYLIC RESIN (SOLIDS)	%
ZINC OXIDE	%	ALKYD RESINS (SOLIDS)	%
CALCIUM CARBONATE	%	VINYL/ACRYLIC CO-POLYMER	%
SILICATES	%	POLYVINYL ACETATE (P.V.A.)	%
MISCELLANEOUS FELDSPARS	%	ETHYLENE GLYCOL	%
	%	VOLATILE (WATER)	%
	%	VOLATILE (SOLVENT)	%
	%		%
	%		%
	%		%
TOTAL	100 %	TOTAL	100 %

VOLATILE ORGANIC COMPOUND (V.O.C.) AS SUPPLIED ?	LBS/GAL	G/L

FINISH OR TOP COAT PRODUCTS

WHAT IS THE 60 DEGREE ANGULAR SHEEN (SATIN OR HIGHER)	UNITS
WHAT IS THE 85 DEGREE ANGULAR SHEEN (FLAT OR MATTE FINISHES)	UNITS
IS THE PRODUCT OFF-CASTED (PIGMENTS ADDED TO INCREASE HIDING POWER)?	
IF COLORS ARE FACTORY ADDED, WHAT PIGMENT IS USED?	

END OF SECTION

SECTION 10 3500 - FLAGPOLES

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Section, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Ground-set, fixed, cone tapered aluminum flagpoles with illuminated finial ball (solar)

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide flagpole assemblies capable of withstanding the effects of wind loads as determined according to the building code in effect for this Project or NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles", whichever is more stringent.
 - 1. Flagged wind speed = 170 mph; 5' x 8' flag size.
- B. Base flagpole design on maximum standard-size flag suitable for use with pole or flag size indicated, whichever is more stringent.

1.4 SUBMITTALS

- A. Product Data: For each type of flagpole required. Include installation instructions.
- B. Shop Drawings: Show general layout, jointing, grounding method. and anchoring and supporting systems.
 - 1. Include detail of foundation system for ground-set poles and electrical wiring diagram for lighted finial.
- C. Structural Calculations: For flagpoles indicated to comply with certain design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each flagpole as a complete unit from a single manufacturer, including fittings, accessories, bases, and anchorage devices. Illuminated finial and truck unit may be obtained from a separate manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Spiral wrap flagpoles with heavy Kraft paper or other weather-tight wrapping and prepare for shipment in hard fiber tube or other protective container.
- B. Deliver flagpoles and accessories completely identified for installation procedure. Handle and store flagpoles to prevent damage or soiling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. A Specifications are based upon products by The Flag Company, Inc. as distributed by The Flagpole Warehouse, Model ILH 30 "Illuminator Series". Subject to compliance with specifications, comparable products by the following manufacturers are acceptable:
 - 1. American Flagpole; a Kearney-National Inc. Company.
 - 2. Baartol Company Inc. (The)
 - 3. Concord Industries, Inc.
 - 4. Eder Flag Manufacturing Company, Inc.
 - 5. Ewing International.
 - 6. Lingo Inc.; Acme Flagpole Division.
 - 7. Michigan Flagpole Inc.
 - 8. Morgan-Francis Div.; Original Tractor Cab Co., Inc.
 - 9. PLP Composite Technologies, Inc.
 - 10. Pole-Tech Company Inc.

2.2 FLAGPOLES

- A. Aluminum Flagpoles: Fabricate from seamless, extruded tubing complying with ASTM B 241, alloy 6063-T6, with a minimum wall thickness of 1/4 inch, tensile strength not less than 30,000 psi, and a yield point of 25,000 psi. Heat treat after fabrication.
 - 1. Provide cone-tapered aluminum flagpoles.
 - 2. Butt diameter: 6"; top diameter: 3-1/2"; exposed height: 30'-0"

2.3 FLAGPOLE MOUNTING

- A. Provide manufacturer's standard base system for the type of flagpole installation required.
- B. Foundation type: For ground-set flagpoles, provide 16-gage minimum galvanized corrugated steel tube, or 12-gage rolled steel tube, sized to suit flagpole and installation. Furnish complete with welded steel

bottom base and support plate, lightning ground spike, and steel centering wedges, all welded construction. Provide loose hardwood wedges at top for plumbing pole after erection. Galvanize steel parts after assembly, including foundation tube.

1. Provide manufacturer's standard flash collar, finished to match flagpole.

2.4 SHAFT FINISH

- A. General: Comply with NAAMM "Metal Finished Manual" for recommendations relative to application and designations of finishes.
- B. Aluminum: Finish designations prefixed by "AA" conform to the Aluminum Association system for designating aluminum finishes.
 1. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.5 FITTINGS

- A. Finial Ball: 8", gold anodized aluminum ball with two, 3 watt, LED bulbs.
 1. Provide transformer: 14 amps, with 12 volt output, 120 volt input, 60 Hz.
 2. Provide photocell for automatic on/off functionality of the LED.
- B. Truck: Ball-bearing, nonfouling, revolving, single sheave assembly of cast aluminum finished to match pole shaft, integrated with illuminated finial ball.
- C. Cleats: Two 9-inch case metal cleats with fasteners, finished to match pole shaft.
- D. Halyards: Provide two continuous halyards for each flagpole, as follows:
 1. Polypropylene, braided, white: 5/16" diameter.
- E. Halyard Flag Snaps: Provide 2 swivel snap hooks per halyard, as follows:
 1. Chromium-plated bronze, with soft plastic covers.

PART 3 - EXECUTION

3.1 PREPARATION FOR GROUND-SET POLES

- A. Excavation: Excavate for foundation concrete to neat clean lines in undisturbed soil or thoroughly compacted fill. Provide forms where required due to unstable soil conditions. Remove wood, loose soil, rubbish, and other foreign matter from excavation, and moisten earth before placing concrete. Back fill open excavation after concreting with original excavated material.
- B. Concrete: Provide concrete composed of Portland cement, coarse and fine aggregate, and water mixed in proportions to attain 28-day compressive strength of not less than 3000 psi, complying with ASTM C 94.
- C. Place concrete immediately after mixing. Consolidate concrete in place by using vibrators. Moist-cure exposed concrete for not less than 7 days or use a nonstaining curing compound.
- D. Finish trowel exposed concrete surfaces to smooth, dense surface. Provide positive slope for water runoff to base perimeter.

3.2 FLAGPOLE INSTALLATION

- A. General: Prepare and install flagpoles where shown and in compliance with shop drawings and manufacturer's instructions.
 1. Provide positive lightning ground for each flagpole installation.
 2. Paint below-grade portions of ground-set flagpole with heavy coat of bituminous paint.
- B. Foundation-tube Installation: Install flagpole in foundation tube, seated on bottom plate between steel centering wedges. Plumb flagpole and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric sealant and cover with flashing collar.
- C. Wiring for illuminated finial: Wire in accordance with manufacturer's directions. Low voltage wiring to be run concealed within pole. Locate transformer as indicated on electrical drawings.

END OF SECTION

SECTION 10 4310 - SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of signs:
 - 1. Panel signs.
 - a. Dimensional letters and numbers.
 - 1) Fabricated numbers.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- C. Shop drawings showing fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.
 - 1. Provide message list for each sign required, including large-scale details of wording and lettering layout.
 - 2. Templates: Furnish full-size spacing templates for individually mounted dimensional letters and numbers.
- D. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.
 - 1. Samples for initial selection of color, pattern, and texture:
 - a. Cast Acrylic Sheet and Melamine Sheet: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.
 - b. Aluminum: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate, showing the full range of colors available.
 - 2. Samples for verification of color, patterns, and texture selected and compliance with requirements indicated:
 - a. Cast Acrylic Sheet and Melamine Sheet: Provide a sample panel not less than 8-1/2 inches by 11 inches for each material, color, texture, and pattern required. On each panel include a representative sample of the graphic image process required, showing graphic style, and colors and finishes of letters, numbers, and other graphic devices.
 - b. Dimensional Letters: Provide full-size representative samples of each dimensional letter type required, showing letter style, color, and material finish and method of attachment.

1.4 QUALITY ASSURANCE

- A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.
- B. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.
- C. All signs shall conform to all requirements of the Americans with Disabilities Act 2010, ADA Standards for Accessible Design, Section 216 - Signs.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Manufacturers of Panel Signs:
 - a. APCO Graphics, Inc.
 - b. ASi Sign Systems
 - c. Clarke Systems
 - d. Best Sign Systems
 - e. Mohawk Sign Systems
 - 2. Manufacturers of Dimensional Letters:

- a. Allen Industries, Inc.
- b. APCO Graphics, Inc.
- c. A.R.K. Ramos Manufacturing Company, Inc.
- d. ASI Sign Systems, Inc.
- e. Gemini Incorporated
- f. Metal Arts
- g. The Southwell Company

2.2 PANEL SIGNS FOR ROOM IDENTIFICATION

- A. Panel signs shall be minimum 1/8" thick (excluding thickness of raised sign letters) melamine or acrylic plastic with 1/32" thick raised characters with Grade 2 Braille.
 - 1. At sign manufacturer's option, the minimum 1/8" thickness of the panel can be achieved by laminating a base layer of melamine or acrylic to the top layer containing the integral raised characters. Edges shall be ground smooth.
 - 2. The characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with the background -either light characters on a dark background or dark characters on a light background. Submit manufacturer's standard palette of colors meeting these requirements to Architect for selection.
 - 3. Graphics and text are to be etched to achieve correctly spaced and accurately reproduced sharp, true characters and Braille. The text shall be an integral part of the sign and not applied to the plate with adhesive or chemicals. Text height is to be determined within the range of 5/8" up to 2". Graphics are etched into the face prior to the application of the background color.
- B. Room identification and number signs are to be provided at each interior door opening and at certain exterior door openings where indicated on drawings.
 - 1. Provide an identification number sign at swinging doors or pairs of doors leading to a room as indicated on drawings. Room numbers to be as indicated on drawings.
 - 2. Provide an identification name sign at swinging doors or pairs of doors leading to a room as indicated on drawings.
 - a. In addition to room number and name signs, include a pictogram of the international symbol of accessibility at each toilet room.
 - b. Example:
 - 1) Room Number Sign: 120
 - 2) Room Name Sign: Men's Toilet
 - 3) Pictogram: Accessibility Symbol
 - 3. General Description of Signs.
 - a. Room number signs shall be combined with room identification signs.
 - 1) Room numbers shall be 3/4" Helvetica Medium Letters centered on sign (capital letter for suffix).
 - 2) Grade 2 Braille centered below number on all signs.
 - 3) Number shall be combined with Identification Sign on a single panel.
 - b. Room Identification Signs.
 - 1) Room identification letters shall be 5/8" upper and lower case Helvetica Medium letters centered on sign.
 - 2) Grade 2 Braille centered on sign.
 - 4. Fabrication: Provide 9 inch by 9 inch overall size. Sign edges are to be straight and free from saw marks or any other imperfections. Corners shall be rounded, with 1/4" to 3/8" radius.

2.3 CAST DIMENSIONAL LETTERS AND NUMBERS

- A. Cast Letters and Numbers: Form individual letters and numbers by casting aluminum. Produce characters with smooth, flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, or other defects. Cast lugs into the back of characters and tap to receive threaded mounting studs. Comply with requirements indicated for finish, style, and size.
- B. Finish: High gloss polyurethane enamel in custom matched colors (two, maximum) to be selected by Architect.
- C. Typeface: Helvetica Medium.
- D. Sizes: 3/4" thick; height and locations indicated on drawings.

2.4 FABRICATED, LARGE SIZE NUMBERS

- A. Fabricated Numbers: Form individual numbers for large number "25" from .250 inch aluminum plate.
 - 1. Aluminum Grade AA3003H22.
 - 2. Weld threaded mounting studs to back of numbers. Sand as required to remove distortion due to welding. Sand edges of fabricated numbers smooth.
- B. Finish.
 - 1. Apply high gloss acrylic polyurethane finish coat over single component epoxy primer after fabrication.
- C. Typeface: Helvetica Neue 85 Heavy.

- D. Sizes: As indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
 - 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
- B. Room Identification Signs: Mount on adjoining walls and locate signs adjacent to the latch side of the door. In case of conflicts with closely spaced doors, with vision panels or where there is no wall space to the latch side of the door, notify Architect. Verify all sign locations with Architect prior to installation.
- C. Wall Mounted Signs: Attach signs to wall surfaces using a minimum of two stainless steel screws. For exterior signs, use four stainless steel screws. Use expansion shields for screws set in masonry; use "Molly" type hollow wall fasteners for screws set in gypsum board or plaster.
 - 1. Mounting shall be at a height of 60" to the centerline of the sign (to centerline of top sign when two signs are mounted one above the other).
- D. Dimensional Letters and Numbers: Mount letters and numbers using standard fastening methods recommended by the manufacturer for letter form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish letter spacing and to locate holes for fasteners.
 - 1. Projected Mounting: Mount cast letters at a 1" projection distance from the wall surface indicated using projecting studs and spacers.

3.2 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to the manufacturer's instruction.
- B. Protect units from damage until acceptance by the Owner.

END OF SECTION

SECTION 10 5220 - FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1- GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 SUMMARY
 - A. This Section includes the following:
 - 1. Fire extinguishers.
 - 2. Fire extinguisher cabinets.
- 1.3 SUBMITTALS
 - A. General: Submit the following according to the Conditions of the Contract.
 - B. Product data for cabinets include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.
 - C. samples for initial selection purposes in the form of manufacturer's color charts consisting of sections of units showing full range of colors, textures, and patterns available for each type of cabinet finish indicated or exposed to view.
- 1.4 QUALITY ASSURANCE
 - A. Single-Source Responsibility: Obtain extinguishers and cabinets from one source from a single manufacturer.
 - B. UL-Listed Products: Fire extinguishers shall be UL listed with UL listing mark for type, rating, and classification of extinguisher.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. J.L Industries.
 - 2. Larsen's Manufacturing Co.
 - 3. Modern Metal Products by Muckle
 - 4. Potter-Roemer, Inc.
 - 5. Samson Metal Products, Inc.
 - 6. Strike First.
- 2.2 FIRE EXTINGUISHERS
 - A. General: Provide fire extinguishers for each cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard, that comply with authorities having jurisdiction.
 - B. Multipurpose Dry Chemical Type: UL-rated 2A-10B:C, 5-lb nominal capacity, in enameled steel container.
 - 1. Provide at all locations except Dining/Day Room.
 - C. Wet Chemical "K Class" Type: UL-rated 2A:1B:C, 6 liter nominal capacity, in enameled steel container.
 - 1. Provide at Dining/Day Room.
 - D. Multipurpose Dry Chemical Type: UL-rated 4A-80B:C, 10 lb. nominal capacity, in enameled steel container.
 - 1. Provide at Fueling Station.
- 2.3 CABINETS
 - A. Construction: Manufacturer's standard box, with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
 - B. Fire-Rated Cabinets: UL listed with UL listing mark with fire-resistance rating of wall where it is installed. Provide wherever cabinet is to be installed in a fire-rated wall or partition.
 - C. Cabinet Type: Suitable for containing the following:
 - 1. Fire extinguisher.
 - D. Cabinet Mounting: Suitable for the following mounting conditions:
 - 1. Semi-recessed: Cabinet box (tub) partially recessed in walls of shallow depth.
 - E. Trim Style: Fabricate trim in one piece with corners mitered, welded, and ground smooth.
 - 1. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - a. Provide 2-1/2 inch rolled edge.
 - F. Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.

1. Enameled Steel: Manufacturer's standard finish, hollow steel door construction with tubular stiles and rails.
 - G. Identify fire extinguisher in cabinet with FIRE EXTINGUISHER lettering applied to door. Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location.
 1. Application Process: Silk screen.
 2. Lettering Style: Horizontal
 3. Lettering Color: White.
 - H. Door Style: Manufacturer's standard design.
 1. Full-Glass Panel: Tempered glass, 1/8 inch thick.
 - I. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.
 - J. Exterior Cabinet: Heavy duty outdoor cabinet constructed of 16 gauge galvanized steel with red acrylic enamel finish. Provide weather-resistant gasketing, safety break cylinder lock, and sloped roof. Door to be solid metal, no glass.
 1. Provide at Fueling Station.
- 2.4 FINISHES FOR CABINETS, GENERAL
- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
 - B. Protect mechanical finishes on exposed surfaces from damage by applying temporary strippable protective covering prior to shipping.
- 2.5 STEEL CABINET FINISHES
- A. A. Surface Preparation: Solvent-clean surfaces complying with SSPS-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5 (white metal blast cleaning) or SSPC-SP 8 (pickling).
 - B. Factory-Priming for Field-Painted Finish: Apply shop primer specified below immediately following surface preparation and pretreatment.
 1. Shop Primer: Manufacturer's or fabricator's standard fast-curing, lead-free, universal primer, selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
 - C. Baked-Enamel Finish: Immediately after cleaning and pretreatment, apply manufacturer's standard two-coat baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's instructions for applying and baking to achieve a minimum dry film thickness of 2.0 mils.
 1. Color: White. Paint the following:
 - a. Exterior of cabinet.
 - b. Interior of cabinet.

PART 3 - EXECUTION

- 3.1 EXAMINATION
- A. Examine walls and partitions for thickness and framing for cabinets to verify cabinet depth and mounting prior to cabinet installation.
 - B. Do not proceed until unsatisfactory conditions have been corrected.
- 3.2 INSTALLATION
- A. Follow manufacturer's printed instructions for installation.
 - B. Install in locations indicated. Each extinguisher requires a cabinet. Mount cabinet with bottom edge of trim located 32" above finished floor.
 1. Prepare recesses in walls for cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions. Recesses in masonry walls shall be neatly sawcut.
 2. Fasten mounting brackets and cabinets to structure, square and plumb.

END OF SECTION

SECTION 10 8000 - TOILET AND BATH ACCESSORIES

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. A Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes toilet and bath accessory items as scheduled, including privacy curtains and curtain rods for bunk rooms.

1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.
- B. Product data for each toilet accessory item specified, including construction details relative to materials, dimensions, gages, profiles, mounting method, specified options, and finishes.
- C. Setting drawings where cutouts are required in other work, including templates, substrate preparation instructions, and directions for preparing cutouts and installing anchorage devices.
- D. Maintenance instructions including replaceable parts and service recommendations.

1.4 QUALITY ASSURANCE

- A. Inserts and Anchorages: Furnish accessory manufacturers' standard inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.

1.5 PROJECT CONDITIONS

- A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based upon products by Bobrick Washroom Equipment, Inc. unless noted otherwise. Subject to compliance with requirements, equivalent toilet accessories by one of the following manufacturers are also acceptable:
 - 1. A & J Washroom Accessories.
 - 2. American Specialties, Inc.
 - 3. Bradley Corporation.
 - 4. McKinney/Parker.

2.2 MATERIALS, GENERAL

- A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 0.034 inch minimum thickness.
- B. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16 (ASTM B 16M); Castings, ASTM B 30.
- C. Sheet Steel: Cold-rolled, commercial quality ASTM A 366 (ASTM A 366M), 0.04 inch minimum. Surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A 527 G60 (ASTM A 527M Z180).
- E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B456, Type SC 2.
- F. Mirror Glass: Nominal 6.0 mm thick, conforming to ASTM C 1036, Type I, Class 1, Quality q2, and with silvering, electro- plated copper coating, and protective organic coating.
- G. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.
- H. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.3 PAPER TOWEL DISPENSERS (PTO)

- A. Surface-Mounted Towel Dispensers: Fabricate of stainless steel with hinged front equipped with tumbler lockset. Provide pierced slots at sides as refill indicator.
 - 1. Capacity: Not less than 400 C-fold or 525 multi-fold paper towels without need for special adapters.
 - 2. Product: Bobrick "Model B-262."

2.4 TOILET PAPER DISPENSERS (TPD)

- A. Double-Roll Dispenser and utility shelf: Size to accommodate two separate rolls of core type tissue up to 5-1/2-inch diameter roll.
 - 1. Fabrication: Chrome-plated plastic spindles with heavy duty internal springs, with type-304 satin-finished, stainless steel brackets designed for surface mounting. Unit includes 16D wide by 5" deep stainless steel shelf with 1/2" return edges, satin finish.

2. Product: Bobrick "B-2840"
- 2.5 SANITARY NAPKIN DISPOSAL (SND)
 - A. Satin-finish stainless steel. Cover is drawn, one-piece construction; secured to cabinet with full-length stainless steel piano-hinge. Capacity: 1.0-gal. (3/8-L). Unit 7 1/2" W, 10" H, 3 13/16" D (190 x 255 x 95mm).
 - B. Surface-Mounted.
 - C. Product: Bobrick "B-270".
- 2.6 GRAB BARS (GB)
 - A. Stainless Steel Type: Provide grab bars with wall thickness not less than 18 gage (.050 inch) and as follows:
 1. Mounting: Concealed, manufacturer's standard flanges and anchorages.
 2. Clearance: 1-1/2 inches clearance between wall surface and inside face of bar.
 3. Gripping Surfaces: Smooth satin finish.
 4. Heavy-Duty Size: Outside diameter of 1-1/2 inches.
 5. Product: Bobrick's "Series B-6806", for 36 inch (GB-36) and 42 inch (GB-42) lengths at toilet stall/room locations as shown. Bobrick's "Series B-6806", for 24 " and 48" units at shower stall locations as shown.
- 2.7 MIRROR UNITS (MIR)
 - A. Stainless Steel Framed Mirror Units: Fabricate frame with angle shapes of not less than 18 gage (.050 inch), with square corners mitered, welded, and ground smooth. Provide in No. 4 satin polished finish. Mirror to be 1/4" tempered glass guaranteed against silver spoilage for 15 years.
 1. Product: Bobrick "Model B-2908-1836" (for toilet rooms).
- 2.8 SHOWER CURTAIN RODS (SCR)
 - A. Stainless Steel, heavy duty type: 1" outside diameter; 18-8, type 304, 20 gage tubing with satin finish. Flanges shall be 20 gage stainless steel with satin finish.
 1. Product: Bobrick "Model B-6107"
- 2.9 ANTIBACTERIAL SHOWER CURTAIN (SC)
 - A. Antibacterial Shower Curtain: 72-inch wide by 72-inch-high, 10-ounce, nylon-reinforced, antibacterial vinyl fabric with hemmed edges. Fabric to be flame proof, stain-resistant and self-deodorizing, with stainless steel grommets at minimum 6 inches o.c. through top hem. Furnish in color as selected by Architect. Provide one per shower stall.
 1. Product: A & J "Model 250A".
 2. Shower Hooks: Provide stainless steel hooks in quantity required by number of eyelets in curtains; A & J "Model UX169 Curtain Ring."
- 2.10 FOLDING DRESSING AREA SEAT
 - A. Folding shower seat shall have a frame constructed of Type-304, satin-finish stainless steel that consists of 16-gauge (1.6mm), 1-1/4" (30mm) square tubing and 18-gauge (1.2mm), 1" (25mm) diameter seamless tubing. Seat shall be one-piece, 5/16" (8mm) thick, solidly fused plastic laminate with matte-finish melamine surfaces, ivory-colored face sheets, and black phenolicresin core; secured to frame with stainless steel carriage bolts and acorn nuts.
 - B. Shower seat shall be equipped with two 3" (75mm) diameter mounting flanges constructed of Type-304, 3/16" (5mm) thick, satin-finish stainless steel; a guide bracket constructed of Type-304, 16-gauge (1.6mm), satin-finish stainless steel; and a spring constructed of Type-301, 24-gauge (0.6mm) stainless steel that is spot-welded to a baseplate of Type-304, heavy-gauge stainless steel. Seat shall be able to lock in upright position when not in use. Shower seat shall comply with accessible design guidelines (including ADAAG in the U.S.A.).
 - C. Product: Bobrick "B-5193".
- 2.11 ROBE HOOK (RH)
 - A. Surface-Mounted Hat and Coat Hook: Heavy-duty satin-finished stainless steel hook welded to rectangular flange and support arm with backplate for concealed mounting.
 1. Product: Bobrick "Model B-6727".
- 2.12 STAINLESS STEEL HOOK STRIP (HS)
 - A. Wall mounted, Clothes hook strip with four hooks. 5 1/2 inch high by 18 inch long satin-finished stainless steel 14 gage.
 1. Product Bobrick "Model B-985" at each bunk room and Corridors where indicated on drawings.
- 2.13 STAINLESS STEEL TOWEL BAR (TB)
 - A. Stainless steel, surface-mounted towel bar with 18 inch long, 3/4" square tubing bar attached to rectangular flanges and support arms with concealed wall plates; satin-finish.

1. Product: Bobrick "Model B-6737 x 18".
- 2.14 MOP AND BROOM HOLDER/UTILITY SHELF (MBH)
 - A. Combination unit with 0.05-inch (18 gage), Type 304, stainless steel shelf with Ya-inch returns, 0.062-inch (16 gage) support brackets for wall mounting. Provide 0.062-inch (16 gage) stainless steel hooks for wiping rags on front of shelf, together with spring-loaded, rubber hat, cam-type mop/broom holders; 1/4 inch diameter stainless steel drying rod suspended beneath shelf. Provide unit 36 inches long and complete with three mop/broom holders and two hooks.
 1. Product: Bobrick "Model 8-224 x 36".
- 2.15 FABRICATION
 - A. General: Only a maximum 1-1/2 inch diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by either a printed, waterproof label or a stamped nameplate, indicating manufacturer's name and product model number.
 - B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.
 - C. Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors or access panels with fu/1- length, stainless steel piano hinge. Provide anchorage that is fully concealed when units closed.
 - D. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent moisture accumulation, as follows:
 1. Provide galvanized-steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.
 - E. Mirror Unit Hangers: Provide system for mounting mirror units that will permit rigid, tamperproof, and theft proof installation, as follows:
 1. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - F. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc.
 1. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install toilet accessory units according to manufacturers' instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.
 - B. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer's instructions for type of substrate involved.
 - C. Install grab bars to withstand a downward load of at least 250 lbf, complying with ASTM F 466.
- 3.2 ADJUSTING AND CLEANING
 - A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
 - B. Clean and polish all exposed surfaces strictly according to manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION

SECTION 10 9500 - MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 SUMMARY
 - A. Provide miscellaneous specialties and related items as required to complete work indicated on Drawings and specified herein. This section includes following:
 - 1. Air Compressor.
 - 2. Controlled Access Pharmaceutical Dispensers.
- 1.3 SUBMITTALS
 - A. Submit product data, shop drawings and samples for each specialty item scheduled for review / approval by Owner and Architect.
- 1.4 QUALITY ASSURANCE
 - A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where necessary to ensure proper fitting of work.
 - B. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or masonry for installation of unit. Provide setting drawings, templates, instructions and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.
 - C. Provide electrical equipment with UL labels.

PART 2 - PRODUCTS

- 2.1 AIR COMPRESSOR
 - A. Portable Air Compressor: Husky-C302H (Basis of Design), ultra-quiet.
 - 1. 30 Gallon.
 - 2. 155 psi.
- 2.2 CONTROLLED ACCESS PHARMACEUTICAL DISPENSER
 - A. Model: CAP 3 Refrigerated.
 - 1. 115 VAC/60Hz
 - 2. 7.0 Amps.
 - 3. Manufacturer: UCaplt.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Examine surfaces to which equipment will be attached, with the Installer present, for compliance with product requirements.
- 3.2 INSTALLATION
 - A. Install equipment plumb and level, in locations and with mountings shown. Securely attach to supporting structure, according to manufacturer's written installation instructions.
 - 1. At frame partitions, provide wood blocking at all connections or fasteners.
- 3.3 CLEANING AND PROTECTING
 - A. At completion of installation, clean surfaces according to manufacturer's written instructions.
 - 1. Protect installed equipment from damage until acceptance by Owner at the time of Substantial Completion.

END OF SECTION

SECTION 11 4510 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Refrigerator/Freezer.
 - 2. Dishwasher.
 - 3. Ice Maker, Commercial.
 - 4. Gas Range.
 - 5. Microwave Oven.
 - 6. Washer.
 - 7. Dryer.

1.3 SUBMITTALS

- A. Product Data: For each appliance type required indicating compliance with requirements. Include complete operating and maintenance instructions for each appliance.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an authorized representative of the residential appliance manufacturer for both installation and maintenance of appliances required for this Project.
- B. Source Limitations: Obtain residential appliances through one source.
 - 1. To the greatest extent possible, provide appliances by a single manufacturer for entire Project, unless noted otherwise in Residential Appliance Schedule.
- C. Electrical Appliances: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- D. UL and NEMA Compliance: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
- E. AGA and ANSI Standards: Provide gas-burning appliances that carry the design certification seal of AGA and that comply with ANSI 221-Series standards.
- F. AHAM Standards: Provide appliances that comply with the following AHAM standards:
 - 1. Refrigerators and Freezers: Total volume and shelf area ratings certified according to ANSI/AHAM HRF-1.
- G. Energy Ratings: Provide residential appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the Federal Trade Commission.

1.5 DELIVERY

- A. Deliver appliances only after utility rough-in is complete and construction in the spaces to receive appliances is substantially complete and ready for installation.

1.6 WARRANTIES

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the appliances indicated for each designation in the Residential Appliance Schedule at the end of Part 3.

2.2 FINISHES

- A. Porcelain-Enamel Finish: Provide manufacturer's standard factory-applied porcelain- enamel finish over cleaned and pretreated steel sheet. If no color is indicated, provide stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for plumbing, mechanical, and electrical services, with Installer present, to verify actual locations of services before residential appliance installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Utilities: Refer to Divisions 15 and 16 for plumbing and electrical requirements.

3.3 ADJUSTING AND CLEANING

- A. Test each item of residential appliances to verify proper operation. Make necessary adjustments.
- B. Verify that accessories required have been furnished and installed.
- C. Remove packing material from residential appliances and leave units in clean condition, ready for operation.

3.4 RESIDENTIAL APPLIANCE SCHEDULE

- A. Refrigerator/Freezer: GE Model GIE21GSHSS, 21.2 Cu. Ft. Top-Freezer Refrigerator.
 - 1. Energy Star.
 - 2. Ice maker.
 - 3. Height: 66.25" (66.75" top of hinge).
 - 4. Width: 32 7/8" (35.5" with door open 90 degrees).
 - 5. Finish: Stainless Steel.
 - 6. Quantity: Provide three (3) refrigerators
- B. Dishwasher: GE Interior Dishwasher with hidden controls.
 - 1. Model: GDT650SYVFS.
 - 2. Finish: Stainless Steel.
- C. Ice Maker: Ice-O-Matic - CIM0530FR.
 - 1. Include Filter System.
 - 2. Provide compatible bin: B40PSB.
 - 3. Condenser: RCA1001.
- D. Range: GE Monogram 36" All-Gas Professional Range ZGP364NDTSS
 - 1. Burners: Four (4), plus Griddle.
 - 2. Fuel Source: Natural Gas. Model - ZGP364NDTSS.
- E. Microwave Oven: GE countertop Microwave: PEB7227ANDD.
 - 1. Capacity: 2.2 Cubic Feet.
 - 2. Provide accessory trim kit for triple oven mount.
 - a. Width: 30" Stainless Steel.
- F. Gear Dryer by Ready Rack.
 - 1. RAM AIR - Gear Dryer: TG-4.
- G. Extractor/Washer by Ready Rack.
 - 1. EW22.
 - 2. Quantity: 2.

END OF SECTION

SECTION 12 2400 - WINDOW SHADES

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Interior manual roller shades.
- 1.2 RELATED REQUIREMENTS
 - A. Section 06 1000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.
- 1.3 REFERENCE STANDARDS
 - A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 - B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
 - C. WCMA A100.1 - Safety of Corded Window Covering Products.
- 1.4 ADMINISTRATIVE REQUIREMENTS
 - A. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
 - 2. Do not install shades until final surface finishes and painting are complete.
- 1.5 SUBMITTALS
 - A. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
 - B. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
 - C. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
 - D. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
 - E. Selection Samples: Include fabric samples in full range of available colors and patterns.
 - F. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.
 - G. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
 - H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Hillsborough County's name and registered with manufacturer.
- 1.6 QUALITY ASSURANCE
 - A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
 - B. Installer Qualifications: Company specializing in performing work of this type with minimum five years of documented experience with shading systems of similar size and type.
 - C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
 - B. Handle and store shades in accordance with manufacturer's recommendations.
- 1.8 FIELD CONDITIONS
 - A. Do not install products under environmental conditions outside manufacturer's absolute limits.
- 1.9 WARRANTY
 - A. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Shade Hardware: One year.
 - 2. Fabric: One year.
 - 3. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
 - A. Interior Manually Operated Roller Shades:
 - 1. MechoShade Systems LLC; UrbanShade Double Roller - Manual: www.mechoshade.com/#sle.
- 2.2 ROLLER SHADES
 - A. General:

1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
2. Provide shade system that operates smoothly when shades are raised or lowered.
- B. Roller Shades:
 1. Basis of Design: MechoShade - UrbanShade.
 2. Description - Interior Roller Shades: Double roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
 - a. Drop Position: Regular roll.
 - b. Roll Direction: Roll down, closed position is at window sill.
 - c. Mounting: Window jamb mounted - inside, between jambs.
 - d. Size: As indicated on drawings.
 - e. Fabric: Blackout White Chelsea 0270 opaque solid, white colored backing. Provide colors for selection.
 - f. Lighter Shade: Thermo Veil Basket Weave 2100 series - 10% fabric openness. Provide colors for selection.
 3. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - a. Material: Stamped steel.
 - b. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.
 - 1) Light-Filtering Fabric: Room-side of opening.
 - 2) Room-Darkening Fabric: Glass-side of opening.
 4. Roller Tubes: As required for type of shade operation.
 - a. Material: Extruded aluminum, clear anodized finish.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
 - d. Take-Up Roller: Manufacturer's standard roller tube pretensioned for winding lift cable in bottom-up type shades.
 5. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Exposed aluminum bottom bar, flat profile with closed ends; clear anodized finish.
 6. Manual Operation for Interior Shades:
 - a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
 - b. Drive Chain: Continuous loop, beaded ball chain with restraining device, 95 lb minimum breaking strength; comply with WCMA A100.1. Provide upper and lower limit stops.
 - c. Chain Retainer:
 - 1) Chain tensioning device complying with WCMA A100.1.
 - 2) Manufacturer's standard clip.- 2.3 SHADE FABRIC
 - A. Fabric for Light-Filtering Shades: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 1. Performance Requirements:
 - a. Flammability: Pass NFPA 701 large and small tests.
 - b. Fungal Resistance: No growth when tested according to ASTM G21.
 2. Color: As selected by Wilder Architecture, Inc. from manufacturer's full range of colors.
 3. Fabrication:
 - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
 - b. If height of opening requires multiple panels of railroaded fabric, use battens at seams.
 - c. Battens: Full width of shade, enclose in welded shade fabric pocket.
- 2.4 ROLLER SHADE FABRICATION
 - A. Field measure finished openings prior to ordering or fabrication.
 - B. Dimensional Tolerances: As recommended in writing by manufacturer.
 - C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Examine finished openings for deficiencies that may preclude satisfactory installation.
 - B. If substrate preparation is the responsibility of another installer, notify Wilder Architecture, Inc. of unsatisfactory preparation before proceeding.
 - C. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Hillsborough County.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.4 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.5 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 3553.23 - SOLID-PLASTIC LABORATORY CASEWORK

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Standard solid-plastic cabinets and cabinet hardware.
- 1.2 RELATED REQUIREMENTS
- 1.3 REFERENCE STANDARDS
 - A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - B. ASTM D4101 - Standard Specification for Polypropylene Injection and Extrusion Materials.
 - C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - D. SEFA 2 - Installations.
 - E. SEFA 3 - Work Surfaces.
 - F. SEFA 8P - Laboratory Grade Polypropylene Casework.
- 1.4 SUBMITTALS
 - A. See Section 01 3000 - Administrative Requirements for submittal procedures.
 - B. Product Data: Details of materials, component dimensions and configurations, construction details, joint details, attachments; manufacturer's catalog literature on hardware and keying, accessories, and service fittings, if any.
 - C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements placement dimensions and tolerances, clearances required, and utility locations, if any. Include coordinated information for laboratory equipment specified in another section and/or furnished by Owner.
 - D. Test Reports: Independent laboratory reports showing compliance with chemical and physical resistance requirements for casework finish.
 - E. Maintenance Data: Manufacturer's recommendations for care and cleaning.
 - F. Finish touch-up kit for each type and color of materials provided.
- 1.5 QUALITY ASSURANCE
 - A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
 - B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. Use polyethylene film or other protective material standard with the manufacturer.
- 1.7 WARRANTY
 - A. Correct defective work within a five year period after Date of Substantial Completion, at no additional cost to Hillsborough County. Defects include, but are not limited to:
 - 1. Discoloration, or lack of finish integrity.
 - 2. Heat-welds or any other structural failure.
 - 3. Failure of hardware.

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
 - A. Obtain casework from single source and manufacturer, unless otherwise indicated.
- 2.2 SOLID-PLASTIC LABORATORY CASEWORK
 - A. Casework: Solid-plastic, each unit self-contained and not dependent on adjacent units or building structure for rigidity; factory-fabricated, factory-assembled, and factory-finished.
 - 1. Style: Flush reveal overlay - square edge.
 - 2. Primary Cabinet Material: Stress-relieved solid polypropylene.
 - a. Polypropylene sheets laminated to metal or wood substrates are not acceptable.
 - b. Finish: Manufacturer's standard smooth/smooth surface polypropylene sheets and components.
 - 1) Color: Black.
 - 3. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings.
 - 4. Polypropylene Case Components: 3/4 inch thick sheets, and as standard with casework manufacturer.
 - 5. Structural Performance: In addition to the requirements of SEFA 3, SEFA 7 and SEFA 8P, provide components that safely support the following minimum loads, without deformation or damage:

- a. Base Units: 400 pounds per linear foot across the cabinet ends.
 - b. Shelves: 75 pounds.
 - 6. Corners and Joints: Without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
 - 7. Edges and Seams: Smooth. Form counter tops, facing, shelves, and drain boards from continuous sheets of material.
 - 8. Welding: Hot-air, full-seam welding.
 - 9. Drawers and Doors: Fabricate door fronts of same materials as cases.
 - 10. Shelves: Adjustable and fixed shelves of same material as cases.
- 2.3 CABINET HARDWARE
- A. Manufacturer's standard styles.
 - B. Shelves in Cabinets:
 - 1. Shelf Rests: Polypropylene, PVC, or ABS plastic clips.
 - C. Swinging Doors:
 - 1. Hinges: Manufacturer's standard, non-metallic hinges and fasteners.
 - 2. Catches: Polyethylene coated magnets embedded in door and frame.
 - 3. Pulls: Polypropylene, recessed 4 inches wide.
- 2.4 COUNTERTOPS
- 2.5 MATERIALS
- A. Polypropylene: Sheets and shapes, ASTM D4101.
 - B. Phenolic Panels: Monolithic core of phenolic resin reinforced with cellulose fibers and manufactured under high pressure and at high temperatures, with melamine-impregnated decorative surface papers; NEMA LD 3 Compact Laminate, Grade CGS.

PART 3 EXECUTION

- 3.1 EXAMINATION
- A. Verify adequacy of support framing and anchors.
 - B. Verify that service connections are correctly located and of proper characteristics.
- 3.2 INSTALLATION
- A. Perform installation in accordance with manufacturer's instructions and with SEFA 2.
 - B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
 - C. Set casework items plumb and square, securely anchored to building structure, with no distortion.
 - 1. Base Cabinets: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 3/4 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
 - a. Install Base Cabinets on 4" concrete base for the full length and width of the cabinet(s) as indicated in the drawings.
 - D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
 - E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
 - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 - 2. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
 - 3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
 - 4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
 - F. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 - G. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
 - H. Replace units that are damaged, including those that have damaged finishes.
- 3.3 ADJUSTING
- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.
- 3.4 CLEANING
- A. Clean casework and other installed surfaces thoroughly.
- 3.5 PROTECTION
- A. Do not permit finished casework to be exposed to continued construction activity.

- B. Protect casework and countertops from ongoing construction activities. Prevent installers from standing on or storing tools and materials on casework or countertops.
- C. Repair damage that occurs prior to Date of Substantial Completion, including finishes, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION

SECTION 21 13 13 - WET PIPE FIRE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-I Specification sections, apply to work of this section.
- B. Refer to other sections of these specifications for related work which is not work of this section.

1.2 SCOPE

- A. A sprinkler layout has been provided for this project. The drawings indicate sprinkler head locations and shall be generally adhered to. Shop drawing submittals shall include coordination with other trades. Any major deviation from the original design shall be brought to the attention of the Architect and Engineer during shop drawing preparation.
- B. This section covers the furnishing and installation of a complete (wet pipe) automatic sprinkler system and appurtenances. The plans show the arrangement and location of major system components. Where incidental equipment or appurtenances are required, and are not listed as shown, same shall be furnished as required for a complete fire protection system. The fire protection system shall comply with the requirements of the current State of Florida adopted NFPA standards and the local authorities having jurisdiction.
- C. Where sprinkler heads have been located on the plans, the head layout shall be generally adhered to.
- D. This is a "center-of-tile" project. Sprinkler heads shall be installed so that they are within 2" of the center-of-tile (or quarter-tile point) in which they are located.
- E. Work included in this specification shall consist of, but is not necessarily limited to, the following items:
 - 1. Arrange for, obtain, and bear the cost of necessary permits, bonds and fees.
 - 2. The fire sprinkler contractor's work shall start at a flanged spigot installed by the underground utility contractor in the locations shown on the fire sprinkler plans. The sprinkler contractor shall not be required to complete any underground work, unless he is contracted to also install the new lead-ins from the water line. The fire sprinkler contractor shall not sign the Underground Material and Test Certificates unless they are responsible for the installation of the fire protection underground.
 - 3. The sprinkler contractor shall furnish and install fire sprinkler systems to protect the buildings as indicated on the drawings. System shall include all pipes, hangers, sprinkler heads, valves, controls, signage and drains necessary for a complete installation. The engineer has shown all of the major components required for these systems, however, the contractor may have to install additional drains, heads and lines based on the field conditions or coordination with other trades. All such additional devices shall be provided for a complete code compliant installation.

4. The sprinkler contractor must furnish and install all flow switches and a 120-volt electric alarm bells at each fire sprinkler riser. The electric alarm bell shall be mounted on the exterior wall outside of each riser room as indicated on the plans. Mount the alarm bells 8'-0" above finished floor or grade elevation. Electrical wiring for these bells shall be performed by the project's electrical contractor.
 5. Rough-in piping shall be flushed in accordance with NFPA-13, and hydrostatically tested with threaded plugs (or temporary drain connections) in place of pendent heads. After all heads are "cut-back" to finishes, a final hydrostatic test shall be performed by the sprinkler contractor and witnessed by the owner's representative.
 6. Furnish complete, coordinated, shop drawings and Aboveground / Underground Material & Test certificates.
 7. Periodically remove from the job site all rubbish or debris resulting from the fire protection work.
- F. All materials and equipment shall be UL listed and bear the UL label.
- G. All threaded connections for the fire department connection shall have threads that meet the requirements of the local fire department.
- H. Furnishing of Electric Drive, Centrifugal Fire Pump in accordance with specification section 21 3113. The fire pump shall be provided in a pre-manufactured fire pump house, designed and constructed by the manufacturer. See fire sprinkler plans for general fire pump house layout.
- I. Furnishing of Fire Water Storage Tank. See fire sprinkler plans for required size and connections.

1.3 STANDARDS, CODES, AND REGULATIONS

- A. Fire protection systems shall meet all provisions of the following adopted standards and codes (by the State of Florida):
1. NFPA National Fire Codes 13, 20, 22, 24, and 101
 2. The Authority Having Jurisdiction
 3. UL - Underwriters' Laboratory
 4. The Florida Fire Prevention Code 2023
 5. The Florida Building Code 2023 (with amendments current at the time of permitting).

1.4 CLASSIFICATION

- A. Office areas, corridors, meeting rooms, training rooms, living spaces and bunk rooms: Designed in accordance with Light Hazard Occupancy (per NFPA 13).
- B. Mechanical rooms, electrical rooms, and small storage rooms: Designed in accordance with Ordinary Hazard Occupancy, Group 1 (per NFPA 13).
- C. Apparatus bay and large storage rooms: Designed in accordance with Ordinary Hazard Occupancy, Group 2 (per NFPA 13).

1.5 SUBMITTALS

- A. Submit complete sets of shop drawings and catalog data for the following:
 - 1. Detailed drawings showing layout of heads, valves, piping and location of all accessories. The engineering drawings shall be used as the basis of the coordination drawings and shall be adhered to as closely as possible. Coordination notes shall be included on the shop drawing submittal.
 - 2. Sprinkler Head Type, Model number, SIN number, Temperature rating, response type, orifice size and thread size.
 - 3. Pipe, fittings, and hanger material.
 - 4. Valves.
 - 5. Electrical devices specific to the fire sprinkler system installation (such as tamper switches, alarm bells, and flow switches).
- B. The contractor shall submit his working drawings to and obtain written approval from the Authority Having Jurisdiction prior to installing the system. In addition, the Working Drawings will require the approval of the Engineer of Record.
- C. The contractor shall specifically prepare plans on the Sprinkler System which shall be indicated by scale. These plans shall show the quantity, location and marking of all system components. Included shall be a description and routing of all piping and indicating all structural components. Prior to fabrication, these drawings shall be coordinated with all other trades shop drawings.

1.6 QUALIFICATIONS OF CONTRACTORS

- A. The contractor for the fire protection installation shall be licensed in the State of Florida as a Fire Protection Contractor, regularly engaged in the installation of automatic fire sprinkler systems and other fire protection equipment.

1.7 QUALIFICATIONS OF INSTALLER

- A. The system shall be installed by an experienced firm utilizing regularly employed and full-time personnel and are regularly engaged in the installation of automatic sprinkler systems in strict accordance with NFPA standards. The fire sprinkler contractor shall not use subcontracted labor without written approval of the Project's Construction Manager.

1.8 CONDUCT OF WORK

- A. Workmanship shall be of high quality, conforming to highest levels of industry standard practice.
- B. The fire protection contractor shall be responsible for any damage to the work of others, to building and property/materials of others caused by leaks in automatic sprinkler equipment, unplugged or disconnected pipes or fittings and shall pay for necessary replacement or repair of work or items damaged during the installation and testing periods of the automatic sprinkler work.

1.9 WARRANTY

- A. All system components furnished under this contract shall be guaranteed against defective design, materials and workmanship for the full warranty time which is standard with the manufacturer and/or supplier, but in no case less than one year from the date of system acceptance.

PART 2 - PRODUCTS

2.1 SPRINKLER HEADS

- A. Sprinkler heads shall be automatic, spray, upright or pendant type, with finishes as noted on the drawings. Heads shall have the temperature rating shown on the drawings or specified herein.
- B. Escutcheons at the ceiling shall match the finish of the associated sprinkler head.
- C. Sprinkler head locations shown on the fire protection plans shall be generally adhered to.
- D. Reference the fire sprinkler design documents for sprinkler head type, response, k-factor, temperature rating, and finish. Substitution of equal sprinkler heads may be permitted through the Submittals process.

2.2 UNDERGROUND FIRE MAIN

- A. Installation of the new fire main, downstream of the fire protection system "Point-of-Service", shall be in accordance with NFPA 24. Refer to the Civil Site Utility specifications for underground material and construction specifications.

2.3 ABOVEGROUND PIPING

- A. Pipe shall be new, designed for 175 psi working pressure, conforming to ASTM Specifications, and have the manufacturer's name or brand, along with the applicable ASTM standard, marked on each length of pipe.
- B. Pipe shall be steel, schedule 40, black and in accordance with specifications ASTM A120 or A53 or schedule 10 black and in accordance with specification ASTM A135.
- C. Schedule 40 black steel pipe shall be joined by screwed joints in accordance with specification ANSI B2.1, by welded joints in accordance with specifications ANSI B31.10, ANSI B31.10a and ANSI B31.1.0b, or by mechanical grooved couplings. Grooves may be rolled or cut and they shall be dimensionally compatible with the coupling.
- D. Schedule 10 black steel ASTM A135 sprinkler pipe shall be joined by UL approved grooved mechanical couplings.
- E. Screwed fittings shall be cast iron, 125 lb. class, black and in accordance with ANSI B16.4 or malleable iron, 150 lb. class, black and in accordance with ANSI B16.3.
- F. Flanged fittings shall be cast iron, short body, Class 125, black and in accordance with ANSI B16.1. Gaskets shall be full face of 1/8" minimum thickness, red sheet rubber. Flange bolts shall be hexagon head machine bolts with heavy semi-finished hexagon head nuts, cadmium plated, having dimensions in accordance with ANSI B18.2.

- G. Grooved couplings and mechanical fittings shall be listed for a minimum 175 psi working pressure, and in accordance with ASTM A47. Coupling gasket material shall be EDPM. Grooved couplings and mechanical fittings shall be tested and listed by UL or FM.
- H. CPVC sprinkler piping shall not be installed on this project.

2.4 FIRE DEPARTMENT CONNECTION

- A. Fire Department Connection (FDC) type shall be coordinated with the local fire department requirements and shall be provided with caps and chains. The location of the FDC is indicated on the fire sprinkler design documents.

2.5 VALVES

- A. Outside screw & yoke (OS&Y) gate valves shall be flanged, iron body, bronze mounted and 175 psi pressure rating, with hand wheel turning counter-clockwise to open. All Valves shall listed by UL. All valves shall be provided with a UL listed valve tamper switch installed by the fire sprinkler contractor.
- B. Butterfly valves may be substituted for OS&Y gate valves and shall be UL listed, iron body rated for 175 psi working pressure. Each valve shall include gear actuator, resilient seating, and flag type position indicator and must contain internal valve tamper switch contacts.
- C. Check valves shall be grooved or flanged, swing type listed for 175 psi fire protection service by UL.
- D. Butterball valves, with built-in tamper switches shall be UL listed, rated for 175 psi working pressure.

2.6 WATER FLOW DETECTORS (FLOW SWITCHES)

- A. Water flow detectors shall be vane type and include sensitivity settings to signal any flow of water equal to the discharge from one sprinkler head, instant recycling pneumatic retard element with adjustable range of 0-70 seconds, two SPDT circuit switches, and be UL listed. Water flow detectors shall not be mounted within 12" of any fitting that changes the direction of the water flow.

2.7 VALVE SUPERVISORY/TAMPER SWITCHES

- A. Provide, at all system shutoff valves, a UL listed/labeled supervisory switch.

2.8 INSPECTOR'S COMBINATION TEST STATION

- A. Provide, where shown on the drawings a UL and FM approved combination inspector's test and drain valve station for the automatic sprinkler system. An integral pressure relief valve, set to relieve pressure at 165 psi, shall be provided with the inspector's test and drain valve station.

2.9 ELECTRIC ALARM BELL

- A. Provide a UL listed fire 120-volt weatherproof alarm bell on the outside of the building on a listed compatible weatherproof back-box for a local fire sprinkler water flow signal.

2.10 IDENTIFICATION SIGNS AND CHARTS

- A. The control, drain, alarm test valves, etc., shall have standard identification signs, painted fire red with white lettering. The signs shall be attached to the valve in a conspicuous position.

2.11 FIRE WATER STORAGE TANK

- A. Fire water storage tank shall comply with NFPA 22.
- B. Basis-of-Design: Contain Water Systems, Inc.
 - 1. CGS-2403-D - 24ft diameter water storage tank, domed roof configuration
 - 2. Nominal Capacity: 36,833 gallons
 - 3. See Manufacturer's specifications.

PART 3 - EXECUTION

3.1 FLUSHING

- A. Before permanently filling the site fire water system with water, and before connections are made to automatic sprinkler risers, all underground piping shall be thoroughly flushed until the water runs clear. Minimum flow rates during flushing shall be based on values given in NFPA 24. An underground piping test certificate shall be filled out and signed by site utility contractor's representative and by an owner's representative and shall be on file by the sprinkler contractor before final sprinkler system commission.

3.2 AUTOMATIC SPRINKLER SYSTEMS

- A. The interior surfaces of all piping and equipment shall be clean and free of all dirt, loose scale, rust and other foreign material before installation.
- B. Pipe ends shall be reamed to remove all burrs and pipe sections shall be cleaned inside to remove all chips and foreign material prior to making up joints. Approved joint compound shall be applied to the threads of the pipe and not in the fitting when making up joints. Pipe shall not extend into the waterway of a fitting.
- C. Sprinkler heads installed where they may be exposed or subjected to mechanical damage shall be furnished complete with head guards.
- D. Welded outlets used on steel piping may be installed only after a clean hole is cut into the pipe of proper size. Welding of outlets onto pipe and torch cutting through the opening will not be permitted. Such fabrication techniques, if discovered will be cause for the removal and replacement of all such improperly fabricated pipe. Drilling of holes or cutting with a plasma arc torch using a template are the only two acceptable means to provide holes for welded outlets or mechanical tees.

3.3 PIPE SUPPORTS

- A. All piping shall be supported by means of hangers tested and listed as approved by UL or as engineered and shown in the plan set. Sizing, spacing and installation shall be in accordance with National Fire Protection Association 13.
- B. No cutting, drilling, welding or burning of any structural steel member shall be allowed without written approval of the structural engineer and consultation with the fire protection engineer.
- C. All bolts and threaded rods shall be used with double nut and washer or single nut washer and lock washer wherever a single unsecured nut could work loose, and allow either threaded rods or supported piping to drop.
- D. Trapeze assemblies shall be constructed using angle iron, or black steel pipe, in sizes indicated by NFPA 13.

3.4 AS-BUILT DRAWINGS / INSPECTION MANUAL

- A. Contractor shall keep an accurate record of the location of all fire protection piping and devices. As-built drawings shall be submitted to the owner's representative before final payment.
- B. The fire sprinkler contractor shall complete all As-Built fire sprinkler drawings (as required by NFPA 13) using Autocad 2013 or later. The sprinkler contractor shall submit a CD with the As-built Drawings showing all changes "clouded" and the revision date/type. A copy of the CD shall be provided to the construction manager
- C. A copy of NFPA 25 "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems" shall be provided to the Construction Manager for transmittal to the School Board Facilities Department.

3.5 TESTS

Testing of the new fire sprinkler system shall be in accordance with NFPA 13 (2019 Edition), Chapter 28. After the system has been completely installed, tested, and accepted by the local AHJ, four (4) hours of direct instruction of the department's personnel shall be provided to assure familiarity with all phases of the operation of the fire sprinkler system.

3.6 WARRANTIES

- A. The fire protection contractor is required to provide a 1-year warranty on all parts, materials, equipment, and workmanship, commencing on the date of substantial completion of the project or phase in which the installation was accepted. This warranty covers all costs associated with the repair or replacement of defective parts, and/or workmanship as well as the removal and replacement of incidental materials.
- B. During the initial one (1) year warranty period, the Owner shall contact the Installer for diagnosis of potential warranty issues. Issues deemed to be the responsibility of the Vendor shall be referred to the Vendor by the Installer, with a notice of same to the Owner. Upon completion of the repair, the Installer is required to confirm that the repairs are acceptable and to notify the Owner. The Installer shall not be entitled to additional compensation for the coordination of warranty repairs.

- C. The Vendor is required to respond to warranty claims within 24 hours of notification and to repair or replace the covered equipment with 72 hours of receipt of request, and to provide temporary replacement equipment when required to maintain acceptable conditions in an occupied facility.
- D. Compile and assemble the warranties into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- E. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

*** END OF SECTION 21 13 13 ***

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

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. In-line fire pumps.
 - 2. Fire-pump accessories and specialties.

1.3 PERFORMANCE REQUIREMENTS

- A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig (1200 kPa) minimum unless higher pressure rating is indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Product Certificates: For each fire pump, from manufacturer.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.

1.5 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. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS

- A. Description: Factory-assembled and -tested fire-pump and driver unit.
- B. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.
- C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

2.2 IN-LINE FIRE PUMPS

- A. Manufacturers: Subject to compliance with requirements.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
 - 1. Peerless Pump, Inc.
 - 2. Or Equal
- C. Pump:
 - 1. Standard: UL 448, for in-line pumps for fire service.
 - 2. Casing: Radially split case, cast iron with ASME B16.1 pipe-flange connections.
 - 3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - 4. Wear Rings: Replaceable bronze.
 - 5. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - 6. Mounting: Pump and driver shaft is vertical, with motor above pump and pump on base.
- D. Coupling: None or rigid.
- E. Driver:
 - 1. Standard: UL 1004A.
 - 2. Type: Electric motor; NEMA MG 1, polyphase Design B.
- F. Capacities and Characteristics:
 - 1. Rated Capacity: 500 gpm
 - 2. Total Rated Head: 80 psi
 - 3. Inlet Flange: Class 125
 - 4. Outlet Flange: Class 125
 - 5. Motor Horsepower: 40 Hp
 - 6. Motor Speed: As required

7. Electrical Characteristics:
 - a. Volts: 208
 - b. Phase: Three
 - c. Hertz: 60
8. Pump-Start, Pump-Stop: Comply with NFPA 20.

2.3 FIRE-PUMP ACCESSORIES AND SPECIALTIES

- A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
- B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.
- C. Relief Valves:
 1. Manufacturers: Subject to compliance with requirements.
 2. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.
- D. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
- E. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.
- F. Hose Valve Manifold Assembly:
 1. Standard: Comply with requirements in NFPA 20.
 2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
 3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
 4. Automatic Drain Valve: UL 1726.
 5. Manifold:
 - a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of in-lets.
 - b. Body: Exposed type, brass, with number of outlets required by NFPA 20.
 - c. Escutcheon Plate: Brass or bronze; round.
 - d. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire department threads. Include caps and chains.
 - e. Exposed Parts Finish: Brass.
 - f. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

2.4 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
 1. Verification of Performance: Rate fire pumps according to UL 448.
- B. Fire pumps will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
- B. Equipment Mounting: Install fire pumps on concrete bases.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Install fire-pump suction and discharge piping sizes as shown on the plans, as required by NFPA 20.
- D. Support piping and pumps separately so weight of piping does not rest on pumps.
- E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Division 21 Section "Wet-Pipe Sprinkler Systems."
- F. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Division 21 Section "Wet-Pipe Sprinkler Systems."
- G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
- H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- I. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

3.3 CONNECTIONS

- A. Comply with requirements for piping and valves specified in Division 21 Section "Wet-Pipe Sprinkler Systems." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect relief-valve discharge to drainage piping or point of discharge.
- D. Connect fire pumps to their controllers.

3.4 IDENTIFICATION

- A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

3.5 FIELD QUALITY CONTROL

- A. Test fire pump with its controller as a unit. Comply with manufacturer's requirements for electric-motor-driver fire-pump controllers.
- 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 components, assemblies, and equipment including controller, test for compliance with requirements.
 - 2. Test according to NFPA 20 for acceptance and performance testing.
 - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Components, assemblies, and equipment will be considered defective if they do 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.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

3.8 WARRANTIES

- A. The fire protection contractor is required to provide a 1-year warranty on all parts, materials, equipment, and workmanship, commencing on the date of substantial completion of the project or phase in which the installation was accepted. This warranty covers all costs associated with the repair or replacement of defective parts, and/or workmanship as well as the removal and replacement of incidental materials.
- B. During the initial one (1) year warranty period, the Owner shall contact the Installer for diagnosis of potential warranty issues. Issues deemed to be the responsibility of the Vendor shall be referred to the Vendor by the Installer, with a notice of same to the Owner. Upon completion of the repair, the Installer is required to confirm that the repairs are

acceptable and to notify the Owner. The Installer shall not be entitled to additional compensation for the coordination of warranty repairs.

- C. The Vendor is required to respond to warranty claims within 24 hours of notification and to repair or replace the covered equipment with 72 hours of receipt of request, and to provide temporary replacement equipment when required to maintain acceptable conditions in an occupied facility.
- D. Compile and assemble the warranties into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- E. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

*** END OF SECTION 21 31 13 ***

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

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

This Section includes the following:

- A. Basic plumbing requirements specifically applicable to Division 22 Sections, in addition to Division 1—General Requirements, General Conditions and Supplementary General Conditions.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Concrete bases.
 - 11. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 INTENT

- A. It is the intention of these specifications and drawings to call for finished work, tested, and ready for operation. Wherever the word "provide" is used, it shall mean "furnish and install complete and ready for use."
- B. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.
- C. The term "Basis of Design" used throughout this document shall be understood to mean a particular manufacturer's equipment (as scheduled specifically on the drawings or specifications) has been used as the basis by the Design Engineer to establish physical dimensions, quality, and performance required, in addition to providing a basis for interaction with other ancillary components and/or other trades. Therefore, it shall be understood that use of a piece of equipment other than that identified as the Basis of Design may impact performance of an overall engineered system or may require revisions to ancillary interfacing equipment, and thus any manufacturer's equipment other than that listed as Basis of Design shall require written approval via Addendum prior to bid except where the manufacturer's name is specifically listed in these specifications as a pre-approved substitute or an accepted manufacturer. All substitutes, pre-approved substitutes, accepted manufacturers, and/or Basis of Design are subject to all requirements of quality, physical characteristics (i.e., dimension, sound, etc), and performance, etc., as set forth in these specifications and contract documents.

1.5 SURVEYS AND MEASUREMENTS

- A. Base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work. All material take-offs for the site shall be field measured prior to bids.

1.6 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the contract. Drawings are not to be scaled. The architectural drawings and details shall be examined for exact location of fixtures and equipment. Where they are not definitely located, this information shall be obtained from the Architect.
- B. If directed by the Architect or Engineer, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.
- C. At the time of each shop drawing submission, the Contractor shall call the Engineer's attention (in writing) to, and plainly mark on shop drawings, any deviations from the Contract Documents. (See Paragraph 1.06, B.)
- D. Samples, drawings, specifications, and catalogs submitted for approval shall be properly labeled indicating specific service for which material or equipment is to be used, location, section and article number of specifications governing, Contractor's name, and name of job. All equipment shall be labeled to match labeling on contract documents.
- E. Catalogs, pamphlets, or other documents submitted to describe items on which approval is being requested, shall be specific and identification in catalog, pamphlet, etc. of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.
- F. Approval rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are approved, said approval does not mean that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the contract drawings and specifications.
- G. All shop drawings shall be submitted to the A/E by Contractor no later than 30 days from the day of contract award.
- H. Failure of the Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension of contract time, and no claim for extension by reason of such default will be allowed.
- I. Submit all Division 22 submittals at one time in one integral group. Piece-by-piece submission of individual items will not be acceptable. Engineer may check contents of each submittal set upon initial delivery; if not complete as set forth herein, submittal sets may be returned to Contractor without review and approval and will not be accepted until made complete.
- J. Routing and methods of support of piping shall be shown on shop drawings and shall have the review of the Engineer prior to fabrication and installation. Spacing of supports shall be as specified in Section 22 05 29, or if not specified, shall not exceed the suggested maximum spacing recommended in ANSI B31.1 for each type of line. Supports shall be fabricated as detailed on reviewed shop drawings. Provide supports so located that temporary supports are not required during removal of valves or equipment. Insofar as possible, support lines directly from Building structure.
- K. At the close of the job, prior to final review, five (5) bound copies of the following shall be submitted by transmittal letter to the Engineer for review and acceptance:
 - 1. Equipment warranties;

2. Contractor's warranty;
3. Parts list and manuals for all equipment;
4. Balance and test readings;
5. Operating instructions (in writing);
6. Written instructions on maintenance and care of the system.

1.7 SUBMITTALS

- A. Product Data: For the following:
 1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.
- B. Welding certificates.
- C. Submit Manufacturer's published technical data, catalog cuts, wiring diagrams, shop drawings, samples and testing and balancing logs for all elements of the plumbing work. Submit under provisions of General Conditions and Supplementary General Conditions.
- D. No equipment, piping, ductwork or components shall be fabricated, delivered, erected, or connected other than from shop drawings reviewed and approved by the Engineer.
- E. It shall be understood that review of shop drawings by the Engineer does not supersede the requirement to provide a complete and functioning system in compliance with the Contract Documents.
- F. Equipment Supports: Submit detailed shop drawings indicating equipment weight and dimensions, support material, connections, anchoring, and vibration isolation.
- G. Submittals shall include, but not be limited to the following:
 1. All equipment; water heaters, plumbing, pumps, etc.
 2. Voltage, phase, and amps of each electrical item, such as motors, etc.
 3. All auxiliary equipment.
 4. Pipe, valves, insulation, etc.

1.8 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
 3. Welded pipe joints shall be made by the oxyacetylene or electric process in accordance with the Code of Pressure Piping ASA B31.1.
 4. Welding shall be done with good quality modern welding equipment, by competent operators, and in thorough, first class manner, conforming to AWS Standards.
 5. The Contractor shall be required to furnish proof of the competency of each welding operator for both field and shop welds and shall at the request of the Architect/Engineer have all or any of such welding operators pass a standard qualification test such as ASME, AWS, or Hartford Insurance Company procedure and tests.
 6. Filler-metal for the welding process shall conform to ASTM A233 "Specification for Mild Steel Arc-Welding Electrodes". Classification of electrodes shall be one of the following: E6010, E6015, E7016, E7018.
 7. When welding is to be performed, precautionary measures must be taken to prevent fire. Remove flammable materials and debris from the area. Provide an appropriate extinguisher nearby.
 8. Pipes shall be cut short and cold sprung into place before welding or fabricating to compensate for expansion of lines when hot.
 9. Welds shall be of the single vee butt type. Pipe end shall be shop beveled to 45 degrees to within 1/16 inch of the inside wall surface.
 10. The abutting ends of the joints shall be separated before welding to permit complete fusion, tacked in two or more points to maintain alignment, and welded. Welding shall be continuous around the pipe.
 11. Welds shall be of sound weld metal, thoroughly fused into the ends of the pipe and to the bottom of the vee, and shall be built up in excess of the pipe wall to give a reinforcement of one-quarter (1/4) the pipe wall thickness and in such a manner that one weld metal will present a gradual increase in thickness from the surface of the pipe to the center of the weld. The minimum width of the weld shall be 2-1/2 times the pipe wall thickness.
 12. The fillet welds from the flanges of fittings shall be fused into the pipe and plate for minimum distance of 1-1/2 times the pipe wall thickness and shall be built up to present a minimum throat thickness of depth of weld of 1-1/4 times the pipe wall thickness.
 13. Branch connections shall be fabricated by welding. Openings cut into pipe for welded connections shall be accurately made to give carefully matched intersections and welding fittings shall be carefully welded into the pipe system.

14. Welding ells shall be used at all turns in welded pipe lines; no mitered ells will be approved.
 15. Where branch piping is three times smaller than the main, branch connections shall be made up with the appropriate manufactured weld-on fitting. Welded tees shall be used for all other branch connections, unless otherwise approved by the Architect/Engineer for a specific case.
 - a. Approved Manufacturers
 - 1) Allied Piping Products.
 - 2) Bonney Forge.
 - 3) Branch Connections.
 - 4) Branchlets.
 - 5) Tube Turn.
 - 6) Thread-O-Lets.
 16. Welds in piping shall be annealed after welding to remove the welding strains. The temperature need not exceed that causing a dull red, and shall be uniform around the pipe. Welds made in place shall be annealed, but the pipe shall be free to expand and shall be properly supported so as to avoid stresses. Annealing shall always be followed by slow cooling.
- D. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.9 SUBSTITUTIONS

- A. Materials and equipment are specified herein by a single or by multiple Manufacturers to indicate quality and performance required. The drawings are based upon equipment scheduled on drawings and specified. If another Manufacturer is considered for substitution during the bidding process, the Mechanical Contractor shall be responsible for coordinating all electrical, mechanical, structural, or architectural changes. Comparable equipment Manufacturers which are listed below equipment indicated as "Basis of Design" shall be considered as substitutes. Manufacturers other than the Basis of Design shall submit catalog information and 1/4" scale plan and section drawings showing proper fit and all clearances for maintenance items.
- B. Substitutions of other Manufacturer's will be considered for use if, in the Engineers opinion, the item requested for substitution is equal to that specified. The Contractor shall provide to the Engineer a typed comparative list of the basis of design and the proposed substitute. The comparative shall list capacities, pressure drops, horse power, electrical requirements, etc.

Request for approval of substitutions shall be made in writing no less than ten (10) days (unless otherwise directed in Division 1) prior to bid. Substitutions shall not be considered approved unless the approval appears in an Addendum or unless so named in the specifications as a pre-approved substitute. The approval of any substitutions or equals prior to bid shall not be construed as a shop drawing approval. The substitute or equal must be submitted as described in the specifications and meet all the requirements of the specifications and drawings.

- C. All requests for substitutions shall be submitted as described in paragraph 1.06, B., and specifically indicate any and all differences or omissions between the product specified as basis of design and the product proposed for substitution. Differences shall include, but shall not be limited to, data as follows for both the specified and substituted products.
 - 1. Principle of operation;
 - 2. Materials of construction or finishes;
 - 3. Thickness or gauge of materials;
 - 4. Weight of item;
 - 5. Deleted features or items;
 - 6. Added features or items;
 - 7. Changes in other Contractor's work caused by the substitution;
 - 8. Physical dimensions;
 - 9. Electrical requirements.
- D. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawing, which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the plumbing or electrical, all such redesign, and all new drawings and detailing required therefore, shall be prepared by the Subcontractor at his own expense and submitted to the Architect/Engineer for approval.
- E. Where such approved deviation requires quantity and arrangement of piping, wiring, conduit, and equipment from that specified or indicated on the drawings, the Contractor shall furnish and install any such ductwork, piping, structural supports, insulation, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.11 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Give full cooperation to other trades and furnish in writing to the General Contractor, with copies to the Architect, any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- E. When work installed under this Division will be in close proximity to, or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer/Architect, prepare composite working drawings and sections at a suitable scale not less than $1/4" = 1'0"$, clearly showing how work is to be installed in relation to the work of other trades. If the work is installed before coordinating with other trades, or so as to cause any interference with work of other trades, make all the necessary changes in work to correct the condition without extra charge.
- F. Furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

1.12 PROTECTION

- A. Protect all work and material provided under this Division from damage. All damaged equipment work or material provided under this Division shall be replaced with new. Re-builds are not acceptable.
- B. Protect all work and equipment until inspected, tested, and accepted. Protect work against theft, injury, or damage; and carefully store material and equipment received on site which are not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of obstructing material.

1.13 SCAFFOLDING, RIGGING, AND HOISTING

- A. Provide all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished. Remove same from premises when no longer required.

1.14 REMOVAL OF RUBBISH

- A. This Contractor shall at all times keep premises free from accumulations of waste materials or rubbish caused by his employees or work. At completion of work he shall remove all his tools, scaffolding, materials, and rubbish from the building and site. He shall leave the premises and his work in a clean, orderly, and acceptable condition.
- B. All plaster, concrete, cement, etc. shall be removed from all pipe, hangers, and equipment prior to painting and/or concealment.

1.15 SAFETY

- A. This Contractor shall comply with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.333), Title 29—Labor, Chapter XIII, Bureau of Standards, Department of Labor, Part 1518—Safety and Health Regulations for Construction; and that his housekeeping and equipment be maintained in such a manner that they comply with the Florida Industrial Commission Safety Code and Regulations of the Federal Williams—Steiger Occupational Safety and Health Act of 1970 (OSHA), wherein it states that the Contractor shall not require any laborer or mechanic employed in the performance of the contract to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health and safety.

1.16 SUPERVISION

- A. This Contractor shall provide a competent, experienced, full time superintendent who is acceptable to the Architect/Engineer and Owner, and who is authorized to make decisions on behalf of the Contractor.

1.17 LUBRICATION

- A. Where necessary, provide means for lubricating all bearings and other machine parts. If a part requiring lubrication is concealed or inaccessible, extend a lubrication tube with suitable fitting to an accessible location and suitably identify it.
- B. After installation, properly lubricate all parts requiring lubrication and keep them adequately lubricated until final acceptance by the Owner.

1.18 VALVE CHARTS, TAGS, AND NAMEPLATES

- A. Provide at a location designated by the Engineer and the Owner, a valve chart enclosed in an aluminum frame with clear plastic shield. Chart shall show the designated number of each valve, its location and service. Valve numbers shall be same as those shown on the "As-Built" drawings.
- B. Each valve shown on the chart shall have a 1-1/2" diameter, 18 gauge brass tag with clearly visible stamped numbers, securely fastened to the valve stem or handle with a heavy brass hook or chain.
- C. Each panel mounted switch, thermometer, gauge, or controller for fans, pumps, or other electrically operated equipment shall be clearly designated by a black plastic nameplate of size approved by the Engineer securely fastened with metal pins or screws to the panel directly under the item designated.
- D. Refer to Section 22 05 53 for additional information.

1.19 WIRING DIAGRAMS

- A. Furnish for use under Division 16 all wiring diagrams as may be required for the installation of the wiring to insure proper operation and control of the equipment provided under this Division. Provide the diagrams in time to avoid delays.

1.20 MATERIAL AND WORKMANSHIP

- A. All materials and apparatus required for the work, except as specifically specified otherwise, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article as approved by the Engineer shall be furnished. Refer to substitutions in this Section.
- B. Unless otherwise specifically indicated on the plans or specifications, all equipment and materials shall be installed with the approval of the Architect and Engineer in accordance with the recommendations of the Manufacturer. This includes the performance of such tests as the Manufacturer recommends.

1.21 QUIET OPERATION AND VIBRATION

- A. All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Engineer and the Owner. In case of moving machinery, sound, or vibration noticeable outside of room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Engineer and the Owner shall be corrected in an approved manner at no additional expense to the Owner. Vibration control shall be by means of approved vibration eliminators in a manner as specified in Section 23 05 48.

1.22 ACCESSIBILITY

- A. This Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in double partitions and hung ceilings for the proper installation of his work. He shall cooperate with all other Contractors whose work is in the same space, and shall advise them of his requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
- B. This Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include but not be limited to, valves, traps, clean-outs, motors, controllers, switchgear, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from drawings may be made to allow for better accessibility.
- C. This Contractor shall provide the access panels for concealed mechanical equipment, valves, controls, dampers, or other device requiring service. (Refer to Paragraph 1.24 of this section.)

1.23 FOUNDATIONS, SUPPORTS, PIERS, AND ATTACHMENTS

- A. This Contractor shall furnish and install all necessary foundations, supports, pads, bases and piers required for all air conditioning equipment, piping, pumps, tanks, compressors, and for all other equipment furnished under this Division, and shall submit drawings to the Architect and Engineer for approval before purchase, fabrication or construction of same.
- B. For pumps, compressors, and other rotating machinery, and for all equipment where foundations are indicated, provide concrete pads as shown. All pads shall be extended six inches (6") beyond machine base in all directions with top edge chamfered. Inset six inch (6") steel dowel rods into floors to anchor pads. All pads shall have a minimum of 6 x 6 W2.9/W2.9 WWF unless otherwise noted. Shop drawings of all foundations and pads shall be submitted to the Architect and Engineer for approval before same are constructed.

- C. Construction of foundations, supports, pads, bases, and piers where mounted on the floor, shall be the same materials and same quality of finish as the adjacent and surrounding flooring material.
- D. All equipment, unless shown otherwise, shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Architect and the Engineer, not strong enough shall be replaced as directed.

1.24 ACCESS DOORS FOR WALLS AND CEILINGS

- A. Provide flush panel access doors with a 16 gauge steel frame and a 14 gauge steel door panel.
- B. Finish is to be primed painted steel.
- C. Provide concealed hinges which allow the door to open 175 degrees and have a removable pin.
- D. Provide access doors with a locked flush mounted vandal proof spanner head operated steel cams.
- E. Provide 1-1/2 hour "B" label door for rated chase walls.
- F. Furnish masonry anchors for installation in masonry walls and metal lath wings with casing bead for plaster installation.
- G. Provide a minimum 2'-0" by 2'-0" access doors unless shown or noted otherwise on the drawings.
- H. Access doors for chase walls shall be mounted 16" off the finish floor.
- I. Access doors for mechanical equipment shall be a minimum of 12" larger than equipment all around.

1.25 VALVE BOXES

- A. All exterior underground valves shall be provided with exterior valve boxes equipped with removable covers appropriately labeled.
- B. Valve boxes shall be manufactured of reinforced fiberglass plastic or heavy duty PVC as approved by the Architect/Engineer, unless otherwise noted on the drawings.

1.26 REGULATORY REQUIREMENTS

- A. Conform to applicable Codes and Standards as follows:
 - 1. Standard
 - a. Certain standard materials and installation requirements are described by reference to standard specifications. These standards are as follows:
 - 1) ASA American Standards Association.

- 2) ASTM.....American Society for Testing Materials.
- 3) ASME American Society of Mechanical Engineers Code of Unfired Pressure Vessels.
- 4) NEMA National Electrical Manufacturers Association.
- 5) UL Underwriters Laboratories.
- 6) ANSI American National Standards Institute.
- 7) ASHRAE.....American Society of Heating, Refrigerating and Air Conditioning Engineers.
- 8) SMACNA Sheet Metal and Air Conditioning Contractor's National Association.
- 9) AMCA Air Moving and Conditioning Association.
- 10) ARI.....Air Conditioning and Refrigeration Institute.
- 11) AMA.....Acoustical Materials Association.

For additional standards and requirements see other sections of the specifications.

Whenever a reference is made to a standard, installation and materials shall comply with the latest published edition at the time project is bid unless otherwise specified herein.

2. Codes And Rules

- a. All material furnished and all work installed shall comply with the following codes as they apply to this project:
 - 1) National Electric Code.
 - 2) Regulations of the Florida Industrial Commission Concerning Safety.
 - 3) Applicable County, State and Local Building Codes.
 - 4) Local and State Fire Marshal Rules and Regulations.
 - 5) Occupational Safety and Health Agency Standards (OSHA).
 - 6) Florida State Board of Health Rules and Regulations.
 - 7) Florida Building Code—Mechanical.
 - 8) Chapter 4A-47, Florida Administrative Code - Uniform Fire Safety Standards for Elevators.

Applicable codes shall be those adopted by the authority having jurisdiction at the time project is bid.

3. Permits, Fees And Inspections

- a. The Contractor shall give all necessary notices, obtain all permits and pay all government fees, sales taxes and other costs, including utility connections or extensions, in connection with this work; file all necessary approvals of all governmental departments having jurisdiction.
- b. Obtain all required certificates of inspection for his work and deliver to the Owner/Engineer the same certificates before request for acceptance and final payment for the work.
- c. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and drawings required to comply with all applicable laws, ordinances, rules and regulations.
- d. The Contractor shall inform the Engineer of any work or materials which conflict with any of the applicable codes, standards, laws and regulations before submitting his bid.

1.27 SCOPE OF WORK

- A. The scope of the work included under this Division of the Specifications shall include complete plumbing systems as shown on the plans and as specified herein. The General Conditions and Special Conditions of these specifications shall form a part and be included under this Section of the Specifications. Provide all supervision, labor, material, equipment, machinery, plant, and any and all other items necessary to complete the plumbing systems. All items of equipment are specified in the singular; however, provide and install the number of items of equipment as indicated on the drawings, and as required for complete systems.
- B. Systems shall include all appurtenances as required to achieve the operating conditions as shown and specified and shall result in a superior installation.
- C. Scope of work shall include, but not be limited to, the following:
 1. New Work
 - a. Provide sanitary systems as shown on drawings.
 - b. Provide gas, domestic hot and cold water system as shown on drawings. Provide new water heaters where indicated on drawings.
 - c. Provide new plumbing fixtures where indicated on drawings.
 - d. Final connections of piping (domestic and HVAC make-up) to equipment and plumbing fixtures.
- D. All electrical work required to support plumbing equipment or is otherwise necessary to operate mechanical equipment, shall be the responsibility of the Plumbing Contractor (including, but not limited to) electrical motors for all motor-operated equipment required under this Division, motor controllers, all starters not provided by the Electrical Contractor (coordinate with Electrical Contractor), pilot lights and relays, line and low voltage control wiring, raceways, connections to switches, and other electrical devices furnished with temperature control systems except as otherwise provided for in other Divisions of this Specification.

- E. Any equipment submitted for prior approval shall be submitted with the following written information specifically for the submitted project application: specific model numbers, dimensional data, performance data and other data as requested by the Engineer. General or ambiguous submittals will not be considered for prior approval.

1.28 PROJECT/SITE CONDITION

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other sections. Obtain permission of Owner/Engineer before proceeding.

1.29 TRENCHING AND BACKFILLING

- A. For requirements for trenching and backfilling, refer to specifications.

1.30 CLOSE-OUT DOCUMENTS

- A. This Contractor shall furnish Operating and Maintenance (O&M) manuals and As-built drawings before final payment will be issued.
 - 1. O&M manuals shall be submitted in accordance with Division 1, General Requirements, and shall consist of the following (at a minimum):
 - a. All Contractor and Manufacturer warranties.
 - b. List of Contractors and Parts and Equipment Suppliers—complete with contact person, proper company name, address, and telephone numbers.
 - c. Parts list for supplied equipment—including a checklist of recommended components to be stocked on-site.
 - d. Maintenance and replacement parts manuals.
 - e. Start-up and shutdown operating instructions.
 - f. Manufacturer's literature describing the equipment, which shall include wiring diagrams and operating specifications.
 - g. Control system sequence of operation, system diagram, and backup disks of the system configuration.
 - h. Copies of final test and balance reports.
 - 2. The Contractor shall provide AutoCAD as-built drawings and copies of each AutoCAD file on CD before final payment will be issued.

1.31 PAINTING

- A. Provide painting and touch-up painting of all exposed piping, ductwork, support structures, etc., and all unfinished equipment (concealed or exposed). Refer to Section 15190 for color scheme requirements of pipes and identification markers.

- B. Deliver materials to job site in new, original, and unopened containers bearing manufacturer's name, trade name, and label analysis. Store where indicated in accordance with manufacturer's instructions.
- C. Do not apply paint in snow, rain, fog or mist or when relative humidity exceeds 85%. Do not apply paint to damp or wet surfaces.
- D. Protect work of other trades. Correct any painting related damages by cleaning, repairing, or replacing, and refinishing, as directed by Engineer.
- E. Provide finish coats which are compatible with prime paints used. Provide barrier coats over incompatible primers where required. Notify Engineer in writing of anticipated problems using specified coatings with substrate primed by others.
- F. Perform preparation and cleaning procedures in strict accordance with coating manufacturer's instructions for each substrate condition.
- G. Remove hardware and accessories, machined surfaces, plates, lighting fixtures and similar items in place and not to be finish-painted or provide surface-applied protection. Re-install removed items and remove protective coverings at completion of work.
- H. Prepare cementitious surfaces of concrete, concrete block, and similar materials to be painted by removing efflorescence, chalk, dust, dirt, grease and oils, and by roughing to remove glaze. Determine alkalinity and moisture content of surfaces to be painted before beginning painting. Do not paint over surfaces where alkalinity or moisture content exceeds manufacturer's recommendations.
- I. Clean ferrous surfaces which are not galvanized or shop-coated. Remove oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning. Touch-up shop-applied prime coats wherever damaged. Clean galvanized surfaces free of oil and surface contaminants with non-petroleum based solvent. Completely paint all welds prior to application of insulation or other protective covering. Non-insulated piping shall be painted entirely.
- J. Mix, prepare, and store painting and finishing materials in accordance with manufacturer's directions. Use applicators, and techniques best suited for materials and surfaces to which applied.
- K. Application
 - 1. Apply painting and finishing materials in accordance with manufacturer's directions. Use applicators, and techniques best suited for materials and surfaces to which applied.
 - 2. Apply additional coats when undercoats, stains or other conditions show through final paint coat, until paint film is of uniform finish, color, and appearance.
 - 3. Paint interior surfaces of ducts, where visible through registers or grilles, flat, non-specular black.
 - 4. Paint back sides of access panels, and removable or hinges covers to match exposed surfaces. Finish exterior doors on tops, bottoms, and edges same as exterior faces, unless otherwise indicated.
 - 5. Sand lightly between succeeding enamel or varnish coats.

6. Apply prime coat to material which is required to be painted or finished, and which has not been prime coated by others.
7. Apply each material at not less than the manufacturer's recommended spreading rate, to provide a total dry film to thickness of not less than 4.0 mils for an entire coating system of prime and finish coats for 3-coat work.
8. Provide a total dry film thickness of not less than 2.5 mils for entire coating system of prime and finish coat for 2-coat work.
9. Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.

- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Eslon Thermoplastics.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Available Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.

- c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.

- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 PIPING SYSTEMS—COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.

- d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
 - f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.

- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION—COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.

- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

*** END OF SECTION 22 05 00 ***

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SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Bronze ball valves.
- 2. Iron ball valves.
- 3. Iron, single-flange butterfly valves.
- 4. Bronze lift check valves.
- 5. Bronze swing check valves.
- 6. Iron swing check valves.
- 7. Chainwheels.

- B. Related Sections:

- 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
- 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- 3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.

- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller[except plug valves].
 - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 2. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.

- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.3 IRON BALL VALVES

A. Class 150, Iron Ball Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. NIBCO.
 - d. Sure Flow Equipment Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Crane.
 - g. Grinnell.
 - h. Milwaukee Valve Company.
- 2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.

- i. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane.
 - b. Grinnell.
 - c. NIBCO INC.
 - d. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane.
 - b. Grinnell.
 - c. NIBCO INC.
 - d. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.

- c. Body Design: Vertical flow.
- d. Body Material: ASTM B 61 or ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.6 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane.
 - b. Grinnell.
 - c. NIBCO INC.
 - d. Milwaukee Valve Company.
- 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.7 IRON SWING CHECK VALVES

A. Class 250, Iron Swing Check Valves with Metal Seats:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane.
 - b. Grinnell.
 - c. NIBCO INC.
 - d. Milwaukee Valve Company.

2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.8 IRON, CENTER-GUIDED CHECK VALVES

A. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane.
 - b. Grinnell.
 - c. NIBCO INC.
 - d. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: EPDM.

2.9 WATER PRESSURE REDUCING VALVES

- ### A. Up to 2 Inches: Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, and single union.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball, butterfly, gate, globe, and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
- G. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- H. Install unions downstream of valves and at equipment or apparatus connections.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: ball, or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: swing check valves with lever and weight or spring unless otherwise noted on the drawings.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 4. For Steel Piping, NPS 2-1/2 and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: Threaded ends.
 - 2. Ball Valves: Three piece, full port, bronze with stainless steel trim.
 - 3. Bronze Swing Check Valves: Class 150, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron Ball Valves: Class 150.
 - 3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.

4. Iron Swing Check Valves: Class 250, metal seats.
5. Iron, Center-Guided Check Valves: Class 250, resilient seat.

*** END OF SECTION 22 05 23 ***

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal-hanger shield inserts.
 - 7. Fastener systems.
 - 8. Pipe positioning systems.
 - 9. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, capable of supporting combined weight of supported systems, system contents, and test water.

- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Fiberglass pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Powder-actuated fastener systems.
 - 5. Pipe positioning systems.
- B. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Fiberglass strut systems. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Available Manufacturers:
 1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. Empire Industries, Inc.
 3. Globe Pipe Hanger Products, Inc.
 4. Grinnell Corp.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts. Provide cast iron roll and stand for hot pipe sizes 6" and over.

2.4 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of stainless steel.
 1. Available Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Champion Fiberglass, Inc.
 - c. Unistrut Corp.; Tyco International, Ltd.
- B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.
 1. Available Manufacturers:
 - a. Plasti-Fab, Inc.

2.5 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Available Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. GS Metals Corp.
 - 3. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 FIBERGLASS STRUT SYSTEMS

- A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.
- B. Available Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Champion Fiberglass, Inc.
 - 3. Seasafe, Inc.

2.7 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Available Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.

2.9 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Available Manufacturers:
 - 1. C & S Mfg. Corp.
 - 2. HOLDRITE Corp.; Hubbard Enterprises.
 - 3. Samco Stamping, Inc.

2.10 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.11 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

- 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

2.12 WALL SUPPORT FOR PIPE 3" AND UNDER

- A. Cast Iron Hook.

2.13 WALL SUPPORT FOR PIPE 4" AND OVER

- A. Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll for hot pipe 6" and over.
- B. Offset Pipe Clamp: Carbon steel, hot dipped galvanized finish (copper plated for copper pipe) for supporting vertical pipe away from wall.

2.14 HANGER RODS

- A. Hanger Rods: Threaded both ends, threaded one end, or continuous threaded. Hanger rods shall be zinc plated steel.

2.15 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.16 FLASHING

- A. Metal Flashing: 22 gage galvanized steel.
- B. Lead Flashing: 5 lb/sq.ft. sheet lead for waterproofing; one lb/sq.ft. sheet lead for soundproofing.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

2.17 SLEEVES

The following are the minimum acceptable requirements for this project. Refer to the plans for more stringent methods and requirements.

- A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gage galvanized steel, unless otherwise directed on the drawings with a more stringent requirement.
- B. Sleeves for Pipes through Non-fire Walls or Footings. Form with steel pipe or 18 gage galvanized steel, unless otherwise directed on the drawings with a more stringent requirement.
- C. Sleeves through outside walls shall be made with 18 gauge galvanized steel and fitted with chrome escutcheon covers at all finished surfaces.

- D. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL Listed. Contractor shall submit manufacturer's UL approved methods for firesafing all types required for the project as coordinated with the methods of floor and wall construction. Refer to the plans for further requirements.
- E. Sleeves for Round Ductwork: Form with galvanized steel.
- F. Sleeves for Rectangular Ductwork: Form with galvanized steel.
- G. Caulk: Silicone sealant of top quality.

2.18 FABRICATION

- A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- B. Design hangers without disengagement of supported pipe.
- C. Provide copper plated hangers and supports for copper piping.

2.19 MATERIAL/FINISH

- A. General Locations: Steel pipe hangers, miscellaneous steel supports, hardware, bolts, washers, nuts, screws, etc., not specified to be plated or coated shall be hot dipped galvanized with a minimum of 1.50 oz/ft. on all sides and all field cuts shall be zinc coated.
- B. Located In or Around Cooling Tower Yards: Pipe hangers, equipment supports, miscellaneous structure components, hardware, bolts, washers, nuts, screws, etc., shall be non-metallic polyester resin, vinyl ester resin, fiberglass, glass reinforced polyurethane or 316 stainless steel.

PART 3 EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.

- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Carbon Steel, Adjustable, Swivel Split-Ring Hangers (MSS Type 6): Copper plated for copper pipe, hot dipped galvanized coating on non-copper pipe. For suspension of noninsulated stationary pipes, NPS 1/2" to NPS 2".
 2. Carbon Steel, Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 2" to NPS 4" and cold pipe sizes 6" and over. Copper plated for copper pipe, hot dipped galvanized coating on non-copper pipe.
 3. Adjustable Steel Yoke-Type Pipe Clamps with Cast Iron Roll, Double Hanger (Hot Dipped Galvanized Coating) (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 6" and over requiring 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 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, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 9. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 10. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 11. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 13. 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.
 14. 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 and with U-bolt to retain pipe.
 15. 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.
 16. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.

17. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 18. 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.
 19. 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.
 20. 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.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
 4. Shield for Insulated Piping 2 Inches and Smaller: 18 gage galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.
 5. Shield for Insulated Piping 2-1/2 Inches and Larger (Except Cold Water Piping): Pipe covering protective saddles.
 6. Shields for Insulated Cold Water Piping 2-1/2 Inches and Larger: Hard block non-conducting saddles in 90 degree segments, 12 inch minimum length, block thickness same as insulation thickness.
 7. Shields for Vertical Copper Pipe Risers: Sheet lead.

- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal 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.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. 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.

- N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- P. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 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 inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 INSERTS

- A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

3.8 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

PIPE SIZE (INCHES)	MAXIMUM HANGER SPACING	HANGER ROD DIAMETER
1/2 to 1-1/4	6'-6"	3/8"
1-1/2 to 2	9'-0"	3/8"
2-1/2 to 3	10'-0"	1/2"
4 to 6	10'-0"	3/4"
8 to 12	14'-0"	7/8"
14 to 18	20'-0"	1"
PVC (All Sizes)	4'-0"	3/8"

- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place a hanger within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor and support from wall midway between ceiling and floor or at 12 feet maximum spacing, whichever is less. Support vertical cast iron pipe at each floor and at each hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. All auxiliary steel required for pipe supports shall be furnished and installed by this Contractor. Where building structure is not usable for pipe supports, provide steel members, channels, angles, or "UNISTRUT" components for piping support. All auxiliary steel exposed to weather shall be galvanized.
- J. Provide all steel required for support of pipes other than steel shown on structural Engineer's drawings.
- K. Interior Pipe Guides, Expansion Loops, and Anchors: Provide pipe guides, expansion loops, and anchors on hot water heating pipes installed above the ceiling. Expansion loops shall be installed every 50 feet and supported from building structure with pipe guides on 10 feet spacing. Piping shall be anchored to the structure as necessary for directional expansion control.

3.9 EQUIPMENT BASES AND SUPPORTS

- A. Provide equipment bases and supports of concrete type under all mechanical equipment and as shown on drawings.

- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.
- E. Refer to Section 23 05 00, Paragraph 1.19, Foundations, Supports, Piers, Attachments, for additional requirements.

3.10 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash and seal.
- C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with Manufacturer's instructions for sound control.

3.11 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.
- C. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk seal. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- D. Install chrome plated steel escutcheons at finished surfaces.
- E. Sleeves installed in exterior walls with exposed ends shall be non-corrosive type sleeves (i.e., stainless steel).

*** END OF SECTION 22 05 29 ***

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 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. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. 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.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Comply with ANSI A13.1.
3. Background Color: Comply with ANSI A13.1.
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.

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.
- B. Letter Color: Comply with ANSI A13.1.
- C. Background Color: Comply with ANSI A13.1.
- 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 and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link 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.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section High-Performance Coatings."
- B. 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 20 feet along each run.

3.4 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; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches.
 - b. Hot Water: 1-1/2 inches.
 - c. Low-Pressure Compressed Air: 1-1/2 inches.
 - d. High-Pressure Compressed Air: 1-1/2 inches.
 2. Valve-Tag Color:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 - c. Low-Pressure Compressed Air: Natural.
 - d. High-Pressure Compressed Air: Natural.
 3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black.
 - c. Low-Pressure Compressed Air: Black.
 - d. High-Pressure Compressed Air: Black.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.6 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.7 INSTALLATION

- A. Metal Tags: Install with heavy brass hook or chain.
- B. Plastic Tape Pipe Markers: Install complete around pipe in accordance with manufacturer's instructions.
- C. Equipment: Identify pumps, heat transfer equipment, tanks, and water treatment devices with plastic equipment markers. Small devices, such as in-line pumps, may be identified with metal tags.
- D. Controls: Identify control panels and major control components outside panels with plastic equipment tags.
- E. Valves: Identify valves in main and branch piping with tags.
- F. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Tags may be used on small diameter piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and "T", at each side of penetration of structure or enclosure, and at each obstruction.
- G. Provide signage for gas vents to indicate the following: "Warning: Flammable Gas Vent".

3.8 VALVE CHART AND SCHEDULE

- A. Provide valve chart and schedule in aluminum frame with clear plastic shield. Install at location as directed.

*** END OF SECTION 22 05 53 ***

SECTION 22 07 00 - PLUMBING INSULATION

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. Insulation Materials:
 - a. Mineral fiber.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Sealants.
 - 6. Factory-applied jackets.
 - 7. Field-applied jackets.
 - 8. Tapes.
 - 9. Securements.
 - 10. Corner angles.
- B. Related Sections include the following:
 - 1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. LEED Submittal:
 - 1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

1.4 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting 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.
- C. Applicator: Company specializing in piping insulation application with three (3) years minimum experience.

1.5 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.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.

1.7 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 Part 3 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. Type C:

Fiberglass Mineral-Fiber, Preformed Pipe Insulation: Conductivity (k) equals approximately 0.23 (BTU-IN/HR, SF, Degree F) at 75 degrees F.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000° Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. 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, without factory-applied jacket.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.

- e. Mon-Eco Industries, Inc.; 22-25.
- 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent elding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 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-C-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 500 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 SEALANTS

- A. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Products, Division of ITW; CP-76.
 - 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: White.
 - 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated tank heads and tank side panels.

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 one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 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. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.

- c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
- 2. Width: 2 inches.
- 3. Thickness: 6 mils.
- 4. Adhesion: 64 ounces force/inch in width.
- 5. Elongation: 500 percent.
- 6. Tensile Strength: 18 lbf/inch in width.
- C. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 - 2. Width: 3 inches.
 - 3. Film Thickness: [4 mils] [6 mils].
 - 4. Adhesive Thickness: 1.5 mils.
 - 5. Elongation at Break: 145 percent.
 - 6. Tensile Strength: 55 lbf/inch in width.

2.8 SECUREMENTS

- A. Continue insulation through pipe hangers. Provide either rigid insulation inserts or sheet metal inserts at all outside pipe hangers. Provide rigid insulation inserts for piping operating below 60 degrees F and sheet metal inserts for piping above 60 degrees F.
- B. Rigid insulation or wood inserts between the pipe and pipe hanger shall be of a thickness equal to the adjoining insulation and shall be provided with vapor barrier where required. Insulation insert shall not be less than the following lengths:
 - 1/2" to 2-1/2" pipe size 10" Long
 - 3" to 6" pipe size 12" Long
 - 8" to 10 pipe size.....16" Long
 - 12" and Over 22" Long
- C. Where insulation is a load bearing material of sufficient strength to support the weight of the piping, pipe shields one-third the circumference of the insulation and of a length not less than three times the diameter of the insulation (maximum length 24") shall be provided. An all service jacket shall be applied between shields and insulation. Follow insulation manufacturer's recommendations for use of pipe insulation in conjunction with outside installed hangers.

- D. Where insulation is not of sufficient strength to support the weight of the piping, a saddle, or section of calcium silicate insulation such as "Kaylo" shall be provided. Vapor barrier and finish shall be applied as required to match adjoining insulation. In addition, shields shall be furnished as specified above.

2.9 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment 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 equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- M. 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.
- N. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.
- O. Apply insulation so as to permit expansion or contraction of pipe lines without causing damage to insulation or surface finish.
- P. The adhesive used in connection with all covering work shall contain an approved vermin and rodent-proof ingredient.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof 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 roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. 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.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. 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 Division 07 Section "Penetration Firestopping" for all firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.

4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. 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.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

3.6 MINERAL-FIBER INSULATION INSTALLATION

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 but 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.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Interior Locations:

1. Install directly over bare insulation or insulation with factory-applied jackets.
 - a. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - b. Embed glass cloth between two 0.062-inch thick coats of lagging adhesive.
 - c. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Exterior and Mechanical Equipment/Storage Rooms:

1. Install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - a. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 DOMESTIC WATER BOILER BREECHING INSULATION SCHEDULE

A. Exposed or concealed breeching and connector insulation shall be one of the following:

1. Calcium Silicate: 4 inches thick.
2. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
3. High-Temperature Mineral-Fiber Board: 3 inches thick and [3-lb/cu. ft.] [6-lb/cu. ft.] nominal density.

3.9 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. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 PIPING INSULATION SCHEDULE

A.

SERVICE	PIPE SIZE	INSULATION TYPE AND THICKNESS
Domestic Hot Water, Tempered Water, Recirculated Hot Water, and Service Hot Water	2" or Less	1" Type C
Domestic Hot Water, Tempered Water, Recirculated Hot Water, and Service Hot Water	2-1/2" or More	1-1/2" Type C
Roof Drain Bodies	All	1-1/2" Type C
Horizontal Rain Water Conductors	All	1-1/2" Type C

*** END OF SECTION 22 07 00 ***

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SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Specialty valves.
4. Flexible connectors.
5. Escutcheons.
6. Sleeves and sleeve seals.
7. Wall penetration systems.

1.3 REFERENCES

- A. ANSI/ASME B16.29—Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings—DWV.
- B. ANSI/ASTM B32—Solder Metal.
- C. ASTM B88—Seamless Copper Water Tube.
- D. AWWA C601—Standard Methods for the Examination of Water and Waste Water.

1.4 SUBMITTALS

- A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.

- 5. Escutcheons.
- 6. Sleeves and sleeve seals.
- 7. Water penetration systems.
- B. LEED Submittal (if required):
 - 1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
- C. Water Samples: Specified in "Cleaning" Article.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61 for potable domestic water piping and components.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Owner's written permission.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

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 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
6. Copper Push-on-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) NVent LLC.
 - b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
7. Copper-Tube Extruded-Tee Connections:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) T-DRILL Industries Inc.
 - b. Description: Tee formed in copper tube according to ASTM F 2014.
8. Grooved-Joint Copper-Tube Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.

- 3) Victaulic Company.
 - b. Copper Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - 2. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - 3. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
- 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - a. Gaskets: AWWA C111, rubber.
 - 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
 - a. Gaskets: AWWA C111, rubber.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: Sheet.
- C. Material: LLDPE film of 0.008-inch minimum thickness or high-density, cross-laminated PE film of 0.004-inch minimum thickness.
- D. Color: Black.

2.6 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.7 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 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. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.

- f. Smith-Blair, Inc; a Sensus company.
- g. Viking Johnson; c/o Mueller Co.

D. Plastic-to-Metal Transition Fittings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
- 2. Description: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socketend.

E. Plastic-to-Metal Transition Unions:

- 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. Colonial Engineering, Inc.
 - b. NIBCO INC.
 - c. Spears Manufacturing Company.
- 2. Description: CPVC four-part union. Include brass threaded end, solvent-cement-joint, plastic end, rubber O-ring, and union nut.

2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 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. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Hart Industries International, Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- f. Zurn Plumbing Products Group; Wilkins Water Control Products.
- 2. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 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. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 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. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.

- e. Washers: Phenolic with steel backing washers.

E. Dielectric 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. Calpico, Inc.
 - b. Lochinvar Corporation.
2. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

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. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Company.
2. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.9 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Flex-Hose Co., Inc.
 2. Flexicraft Industries.
 3. Flex Pression, Ltd.

4. Flex-Weld, Inc.
 5. Hyspan Precision Products, Inc.
 6. Mercer Rubber Co.
 7. Metraflex, Inc.
 8. Proco Products, Inc.
 9. Tozen Corporation.
 10. Unaflex, Inc.
 11. Universal Metal Hose; a Hyspan company
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.10 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.

2.11 SLEEVES

- A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

2.12 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Advance Products & Systems, Inc.
 2. Calpico, Inc.

3. Metraflex, Inc.
4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe 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.

2.13 WALL PENETRATION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. SIGMA.
- B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
 2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
 3. Housing-to-Sleeve Gasket: EPDM rubber.
 4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
 5. Pipe Sleeve: ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe.

2.14 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- G. Install domestic water piping with 0.25 percent slope downward toward drain and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. 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.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping adjacent to equipment and specialties to allow service and maintenance.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump.

- S. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- T. Install thermometers on outlet piping from each water heater.
- U. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- V. Route piping in orderly manner and maintain gradient.
- W. Install piping to conserve building space and not interfere with use of space.
- X. Group piping whenever practical at common elevations.
- Y. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- Z. Provide clearance for installation of insulation and access to valves and fittings.
- AA. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with General Contractor.
- BB. Slope water piping and arrange to drain at low points.
- CC. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover, or as existing piping connections require.
- DD. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- EE. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- FF. Copper piping installed below grade shall be wrapped with $\frac{3}{4}$ " Armaflex pipe insulation. Seal all edges and seams to prevent moisture intrusion.
- GG. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum. Maintain gradients.
- HH. Excavate in accordance with sections on Excavation and Backfill.
- II. Install bell and spigot pipe with bell end upstream.
- JJ. Install valves with stems upright or horizontal, not inverted.
- KK. Install silicon iron waste and vent pipe in accordance with manufacturer's recommendations.
- LL. Pipe cold water to both hand mixing valves of sinks and lavatories when only cold water is designated for connection unless otherwise noted on the drawings.
- MM. Use grooved mechanical couplings and fasteners only in accessible locations.
- NN. Install unions downstream of valves and at equipment or apparatus connections.
- OO. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

- PP. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- QQ. Install globe valves for throttling, bypass, or manual flow control services.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. 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:
- D. Apply appropriate tape or thread compound to external pipe threads.
- E. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- F. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- G. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- H. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- I. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- J. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- K. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- M. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
- N. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
- O. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- P. PVC Piping: Join according to ASTM D 2855.

- Q. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
- C. NPS 1-1/2 and Smaller: Fitting-type coupling.
- D. NPS 2 and Larger: Sleeve-type coupling.
- E. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish.
 - 5. Bare Piping in Equipment Rooms: One piece, cast brass
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.10 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. PVC pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.

5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - d. Do not use sleeves when wall penetration systems are used.
6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.11 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- C. Piping Tests:
 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. 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 a separate report for each test, complete with diagram of portion of piping tested.
 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 4. 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.
 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.14 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.15 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1. Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2. Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.16. PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

- D. Outside buildings, below grade domestic water piping, all sizes, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K, ASTM B 88M, Type B; wrought-copper solder-joint fittings; and brazed fittings; and pressure-sealed joints.
- E. Under-building-slab, domestic water piping, all sizes, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K, ASTM B 88M, Type B; wrought-copper solder-joint fittings; and brazed fittings; and pressure-sealed joints.
 - 2. Fittings outside of building shall be ANSI/ASME B16.29, wrought copper. Joints: ANSI/ASME B32, solder, Grade 95TA.
 - 3. Fittings are not permitted below floor. Fittings at equipment shall be compression type.
- F. Aboveground domestic water piping, all sizes, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L copper solder-joint fittings; and soldered joints.

3.17 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

*** END OF SECTION 22 11 16 ***

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated water mixing valves.
 - 6. Strainers.
 - 7. Outlet boxes.
 - 8. Hose stations.
 - 9. Hose bibbs.
 - 10. Wall hydrants.
 - 11. Ground hydrants.
 - 12. Post hydrants.
 - 13. Drain valves.
 - 14. Water hammer arresters.
 - 15. Air vents.
 - 16. Trap-seal primer valves.
 - 17. Trap-seal primer systems.
- B. Related Sections include the following:
 - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Division 22 Section "Domestic Water Piping" for water meters.

3. Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Division 22 Section "Healthcare Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
6. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 1. Vacuum breakers.
 2. Backflow preventers.
 3. Water pressure-reducing valves.
 4. Balancing valves.
 5. Temperature-actuated water mixing valves.
 6. Water hammer arresters.
 7. Air vents.
 8. Trap-seal primer valves.
 9. Trap-seal primer systems.
- B. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. NSF Compliance:
 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1001.
4. Size: NPS 1/4 to NPS 3, as required to match connected piping.
5. Body: Bronze.
6. Inlet and Outlet Connections: Threaded.
7. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Woodford Manufacturing Company.
 - c. Zurn Plumbing Products Group; Light Commercial Operation.
 - d. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1011.
4. Body: Bronze, nonremovable, with manual drain.
5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
6. Finish: Chrome or nickel plated.

C. Laboratory-Faucet Vacuum Breakers:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Woodford Manufacturing Company.
 - c. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1035.
4. Size: NPS 1/4 or NPS 3/8 matching faucet size.
5. Body: Bronze.
6. End Connections: Threaded.
7. Finish: Chrome plated.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:
 - a. Flomatic Corporation.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
4. Standard: ASSE 1013.
5. Operation: Continuous-pressure applications.
6. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
7. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

9. Configuration: Designed for horizontal, straight through flow. ANSI/ASSE 1013; bronze body with bronze and plastic internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
10. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators for Water Piping Less Than 1":

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Honeywell Water Controls.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1003.
4. Pressure Rating: Initial working pressure of 150 psig.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
6. Include integral thermal expansion bypass.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.
8. Include stainless steel integral strainer, renewable stainless steel seat, high temperature diaphragm, and 160# gauge and tapping.

B. Water Control Valves for Water Piping 1" and Greater:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:
 - a. Watts Industries, Inc.; Ames Fluid Control Systems.
 - b. Watts Industries, Inc.; Watts ACV.
 - c. Zurn Plumbing Products Group; Wilkins Div.
4. Description: Pilot-operation, diaphragm-type, single-seated main water control valve with integral thermal expansion bypass.
5. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
6. Main Valve Body: Bronze body with AWWA C550 or FDA-approved, interior epoxy coating.
 - a. Pattern: Globe-valve design.
 - b. Trim: Stainless steel.
7. Include stainless steel integral strainer, renewable stainless steel seat, high temperature diaphragm, and 160# gauge and tapping.

2.4 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Red-White Valve Corp.
3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
4. Pressure Rating: 400-psig minimum CWP.
5. Size: NPS 2 or smaller.
6. Body: Copper alloy.

7. Port: Standard or full port.
8. Ball: Chrome-plated brass.
9. Seats and Seals: Replaceable.
10. End Connections: Solder joint or threaded.
11. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Symmons Industries, Inc.
4. Standard: ASSE 1017.
5. Pressure Rating: 125 psig.
6. Type: Cabinet-type, thermostatically controlled water mixing valve.
7. Material: Bronze body with corrosion-resistant interior components.
8. Connections: Threaded union inlets and outlet.
9. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
10. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
11. Valve Finish: Rough bronze.
12. Piping Finish: Copper.
13. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

B. Individual-Fixture, Water Tempering Valves:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leonard Valve Company.
 - b. Powers; a Watts Industries Co.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1016, thermostatically controlled water tempering valve.
4. Pressure Rating: 125 psig minimum, unless otherwise indicated.
5. Body: Bronze body with corrosion-resistant interior components.
6. Temperature Control: Adjustable.
7. Inlets and Outlet: Threaded.
8. Finish: Rough or chrome-plated bronze.

2.6 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Metal bellows or copper tube with piston.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.7 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.8 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sioux Chief Manufacturing Company, Inc.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig minimum.
5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

1. 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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
3. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
4. Size: NPS 1-1/4 minimum.
5. Material: Chrome-plated, cast brass.

2.9 THERMOMETERS

- A. Provide thermometers with needle type shut-off valves. They shall be installed so that they can be clearly read from the floor.
- B. Industrial stem thermometers shall have a scale not less than 9" long and shall be red-reading mercury type with white background and black etched graduations and numerals.
- C. Thermometers shall be suitable for the service intended and the range shall be selected to span from approximately 10 degrees below through 10 degrees above the operating range of the fluid.
- D. Thermometers shall have a guaranteed accuracy of within 1% of the range scale and shall be provided with 1 degree graduations. Thermometers shall be provided with brass separable socket wells.
- E. Provide thermometer wells and necessary fittings where specified or indicated. Wells installed in insulated piping shall be provided with lagging extensions of appropriate length to accommodate insulation. Where wells are provided without thermometers or thermostats, a plug and chain shall be provided. The insertion length of wells shall be compatible with the pipe diameter in which they are installed. Wells shall be provided with graphite mixture.
- F. Thermometers shall be as manufactured by Weksler, Marsh Instruments, or Ametek.

2.10 ESCUTCHEONS

- A. Chrome plated or stainless steel with set screws for holding securely in place.

2.11 DIELECTRIC FITTINGS

- A. Metal parts of union or flange shall be installed to prevent current flow between dissimilar metals. EPCO Dielectric pipe fittings or equivalent.

2.12 VENT FLASHING

- A. 16 ounce copper or 4 pound lead flashing and counter flashing.

2.13 T&P RELIEF VALVES

- A. Valve shall have bronze body, non-mechanical seat-to-disc alignment and shall have a stainless steel thermostat.

- B. Valve shall contain an emergency back-up fusible plug.
- C. The valves shall be sized on the AGA temperature steam rating.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve and pump.
- H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- I. Install water hammer arresters in water piping according to PDI-WH 201.
- J. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

- K. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- L. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Water pressure-reducing valves.
 - 3. Primary, thermostatic, water mixing valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 PREPARATION

- A. Coordinate forming of roof and floor construction to receive drains to required invert elevations.

3.5 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install water hammer arresters complete with isolation valve. The water hammer arresters and isolation valve shall be installed in a location accessible through the ceiling. Provide access doors as necessary. Coordinate location of access doors with Architect/Engineer and other trades. Access door shall be sized to allow removal and replacement of concealed device or equipment.
- E. Locate trap primer under lavatory on CW supply and/or flush valve as per manufacturer's recommendations.

- F. Use escutcheons on pipes passing through walls, floors, and ceilings of finished areas.
- G. Seal all openings in sleeves for piping penetrations with UL listed caulk. Refer to detail on drawings.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principle according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.7 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

*** END OF SECTION 22 11 19 ***

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SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Sewerage Pumps."

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.4 REFERENCES

- A. ANSI/ASME B16.29—Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings—DWV.
- B. ANSI/ASTM B32—Solder Metal.
- C. ASTM A74—Cast Iron Soil Pipe and Fittings.
- D. ASTM A-518—Acid Resistant Close Grained Cast Iron.
- E. ASTM B88—Seamless Copper Water Tube.

- F. ASTM C564—Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- G. AWWA C601—Standard Methods for the Examination of Water and Waste Water.

1.5 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
 - 2. Sanitary Sewer, Force-Main Piping: 50 psig .

1.6 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. LEED Submittal:
 - 1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
- C. Shop Drawings:
 - 1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
 - 2. Sovent Drainage System: Include plans, elevations, sections, and details.
- D. Field quality-control inspection and test reports.

1.7 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. An other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Solvent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. Shielded Couplings: ASTM C 1277 assembly of metal shield on housing, corrosion resistant fasteners, and rubber sleeve with integral center pipe stop.
 - 1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO.
 - 2) Clamp-All Corp.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.

2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- B. Solvent Cement and Adhesive Primer:
 - 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping shall be the following:
 - 1. Cast iron pipe and fittings; Joints: No hub pipe and fittings with ASTM C1277, CISPI-310 heavy-duty, double banded couplings.
- C. Aboveground, vent piping shall be the following:
 - 1. Cast iron pipe and fittings; Joints: No hub pipe and fittings with ASTM C1277, CISPI-310 heavy-duty, double banded couplings.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
 - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Underground, soil and waste piping NPS 5 and larger shall be the following:
 - 1. Solid-wall, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.

3.3 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- E. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- F. 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.

- G. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. 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.
- H. Lay buried building 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.
- I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- J. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- L. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
- M. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- N. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Route piping in orderly manner and maintain gradient.
- Q. Install piping to conserve building space and not interfere with use of space.
- R. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover, or as existing piping connections require.

- S. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum. Maintain gradients.
- T. Excavate in accordance with sections on Excavation and Backfill.
- U. Install bell and spigot pipe with bell end upstream.
- V. Install silicon iron waste and vent pipe in accordance with manufacturer's recommendations.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- G. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

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 sewage pump discharge.
- C. Install gate or full-port ball valve for piping NPS 2 and smaller.
- D. Install gate valve for piping NPS 2-1/2 and larger.
- E. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- F. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.

4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
 1. Sanitary Sewer: To exterior force main or sanitary manhole.
 2. Sewage Pumps: To sewage pump discharge.

3.7 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.

3.8 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

*** END OF SECTION 22 13 16 ***

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SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Floor drains.
 - 4. Trench drains.
 - 5. Channel drainage systems.
 - 6. Air-admittance valves.
 - 7. Roof flashing assemblies.
 - 8. Through-penetration firestop assemblies.
 - 9. Miscellaneous sanitary drainage piping specialties.
 - 10. Flashing materials.
 - 11. FOG disposal systems.
 - 12. Grease interceptors.
 - 13. Grease removal devices.
 - 14. Oil interceptors.
 - 15. Solids interceptors.
- B. Related Sections include the following:
 - 1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
 - 2. Division 22 Section "Plumbing Fixtures" for hair interceptors.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.

- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. Boiler water valves.
 - 2. Grease interceptors.
 - 3. Air admittance valves.
 - 4. Oil interceptors.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 PRODUCTS

2.1 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - 1. 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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Watts Drainage Products Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
 4. Standard: ASME A112.14.1.
 5. Size: Same as connected piping.
 6. Body: Cast iron.
 7. Cover: Cast iron with bolted access check valve.
 8. End Connections: Hub and spigot or hubless.
 9. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
 10. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves:
1. 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:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Watts Drainage Products Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
 3. Size: Same as floor drain outlet.
 4. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 5. Check Valve: Removable ball float.
 6. Inlet: Threaded.
 7. Outlet: Threaded or spigot.
- C. Horizontal, Plastic Backwater Valves:
1. 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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Plastic Oddities; a division of Diverse Corporate Technologies.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Zurn Plumbing Products Group; Light Commercial Operation.
3. Size: Same as connected piping.
4. Body: PVC.
5. Cover: Same material as body with threaded access to check valve.
6. Check Valve: Removable swing check.
7. End Connections: Socket type.

2.2 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Oatey.
 - b. ProSet Systems Inc.
 - c. RectorSeal.
 - d. Studor, Inc.
3. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
4. Housing: Plastic.
5. Operation: Mechanical sealing diaphragm.
6. Size: Same as connected fixture or branch vent piping.

B. Stack Air-Admittance Valves:

1. 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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Durgo, Inc.
 - b. Oatey.
 - c. Studor, Inc.
3. Standard: ASSE 1050 for vent stacks.
4. Housing: Plastic.
5. Operation: Mechanical sealing diaphragm.
6. Size: Same as connected stack vent or vent stack.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. 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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
4. Size: Same as connected soil, waste, or vent stack.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.

2.5 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Applications: 12 oz./sq. ft. thickness.
 2. Vent Pipe Flashing: 8 oz./sq. ft. thickness.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- H. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.
- I. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- J. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- K. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- L. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- M. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- N. Assemble open drain fittings and install with top of hub 1 inch above floor.

- O. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- P. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- Q. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- R. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- S. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- T. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 - 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 - 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- U. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain with Division 23 Section "Facility Fuel-Oil Piping."
- V. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.
- W. Install wood-blocking reinforcement for wall-mounting-type specialties.
- X. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- Y. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- D. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.6 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Use escutcheons on pipes passing through walls, floors, and ceilings of finished areas.
- E. Seal all openings in sleeves for piping penetrations with UL listed caulk. Refer to detail on drawings.

*** END OF SECTION 22 13 19 ***

SECTION 22 33 00 - ELECTRIC DOMESTIC WATER HEATERS

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 electric water heaters:

1. Light-commercial electric water heaters.
2. Water heater accessories.

1.3 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. LEED Submittal:
 - 1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with ASHRAE/IESNA 90.1-2004, Section 7 - "Service Water Heating."
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Product Certificates: For each type of commercial and instantaneous electric water heater, signed by product manufacturer.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For electric water heaters to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- C. 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.

- D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.
- E. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period(s): From date of Substantial Completion:
 - a. Light-Commercial Electric Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: Two years.
 - c. Compression Tanks: One year.

PART 2 PRODUCTS

2.1 LIGHT COMMERCIAL ELECTRIC WATER HEATERS

- A. Description: Comply with UL 174 for household, storage electric water heaters.
 - 1. Manufacturers:
 - a. American Water Heater Company.
 - b. Bradford White Corporation.
 - c. Electric Heater Company (The); Hubbell Heaters Division.
 - d. GSW Water Heating Company.

- e. Heat Transfer Products, Inc.
 - f. Lochinvar Corporation.
 - g. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - h. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - i. Smith, A. O. Water Products Company.
 - j. State Industries, Inc.
2. Storage-Tank Construction: Steel, vertical arrangement.
- a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
3. Factory-Installed Storage-Tank Appurtenances:
- a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1-2004.
 - e. Jacket: Steel with enameled finish.
 - f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation, unless otherwise indicated.
 - h. Temperature Control: Adjustable thermostat for each element.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
4. Special Requirements: NSF 5 construction with legs for off-floor installation.

2.2 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.
- C. Water Heater Stand and Drain-Pan Units: High-density-polyethylene-plastic, 18-inch- high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1 pipe thread.
- D. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- E. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
- F. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.
- G. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that are capable of isolating each water heater and of providing balanced flow through each water heater.
- H. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004.
- I. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig maximum outlet pressure, unless otherwise indicated.
- J. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

2.3 SOURCE QUALITY CONTROL

- A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
- C. Prepare test reports.

PART 3 EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 - 2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
- F. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- G. Install thermometers on inlet and outlet piping of household, collector-to-tank, solar-electric water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- H. Install pressure gage(s) on outlet of commercial electric water- heater piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- I. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves and to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- J. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.
- K. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- L. Fill water heaters with water.

- M. Charge compression tanks with air.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 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. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and instantaneous electric water heaters. Refer to Division 01 Section "Demonstration and Training."

*** END OF SECTION 22 33 00 ***

SECTION 22 40 00 - PLUMBING FIXTURES

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 conventional plumbing fixtures and related components:
 - 1. Protective shielding guards.
 - 2. Fixture supports.
 - 3. Interceptors.
 - 4. Dishwasher air-gap fittings.
 - 5. Disposers.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
 - 2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.

- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. LEED Submittal:
 - 1. Product Data for Credit WE 2, 3.1, and 3.2: Documentation indicating flow and water consumption requirements.
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act" for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Bathtubs: ANSI Z124.1.

3. Plastic Lavatories: ANSI Z124.3.
 4. Plastic Laundry Trays: ANSI Z124.6.
 5. Plastic Mop-Service Basins: ANSI Z124.6.
 6. Plastic Shower Enclosures: ANSI Z124.2.
 7. Plastic Sinks: ANSI Z124.6.
 8. Plastic Urinal Fixtures: ANSI Z124.9.
 9. Plastic Whirlpool Bathtubs: ANSI Z124.1 and ASME A112.19.7M.
 10. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 11. Slip-Resistant Bathing Surfaces: ASTM F 462.
 12. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 13. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 14. Stainless-Steel Residential Sinks: ASME A112.19.3.
 15. Vitreous-China Fixtures: ASME A112.19.2M.
 16. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 17. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 18. Whirlpool Bathtub Fittings: ASME A112.19.8M.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 4. Faucets: ASME A112.18.1.
 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 8. NSF Potable-Water Materials: NSF 61.
 9. Pipe Threads: ASME B1.20.1.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.

11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for bathtub/shower faucets:
 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
 4. Faucets: ASME A112.18.1.
 5. Hand-Held Showers: ASSE 1014.
 6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 7. Hose-Coupling Threads: ASME B1.20.7.
 8. Manual-Control Antiscald Faucets: ASTM F 444.
 9. Pipe Threads: ASME B1.20.1.
 10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 1. Disposers: ASSE 1008 and UL 430.

2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Hot-Water Dispensers: ASSE 1023 and UL 499.
8. Off-Floor Fixture Supports: ASME A112.6.1M.
9. Pipe Threads: ASME B1.20.1.
10. Plastic Shower Receptors: ANSI Z124.2.
11. Plastic Toilet Seats: ANSI Z124.5.
12. Supply and Drain Protective Shielding Guards: ICC A117.1.
13. Whirlpool Bathtub Equipment: UL 1795.

1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of equipment that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 2. Warranty Period for Commercial Applications: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 1. 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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
3. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.2 FIXTURE SUPPORTS

- A. Refer to Plumbing Schedules on drawings.

2.3 INTERCEPTORS

- 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. Josam Company.
 2. MIFAB Manufacturing Inc.
 3. Smith, Jay R. Mfg. Co.
 4. Tyler Pipe; Wade Div.
 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- C. Hair Interceptors:
 1. Description: Manufactured unit with removable screen or strainer and removable cover; designed to trap and retain hair.
 - a. Material: Brass body.
 - b. Pipe Connections: NPS 1-1/4.

D. Sediment Interceptors:

1. Description: Manufactured unit with removable screens or strainer and removable cover; designed to trap and retain waste material.
 - a. Material: Cast-iron or steel body with acid-resistant lining and coating.
 - b. Pipe Connections: NPS 1-1/2.

2.4 DISHWASHER AIR-GAP FITTINGS

- A. Refer to Plumbing Schedules on drawings.

2.5 DISPOSERS

- A. Refer to Plumbing Schedules on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounting fixtures in and attached to casework.

- H. Install fixtures level and plumb according to roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- N. Install toilet seats on water closets.
- O. Install trap-seal liquid in dry urinals.
- P. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- R. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- S. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- T. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- U. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- V. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck. Connect inlet hose to dishwasher and outlet hose to disposer.
- W. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

- X. Set bathtubs and service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- Y. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."
- Z. Provide a cast brass trap at each fixture with removable cleanout for servicing and cleaning.
- AA. Provide chrome plated stops with rigid supplies to fixtures with loose key stops, reducers, and escutcheons. All stops shall have renewable seats and disks.
- BB. Install components level and plumb.
- CC. Install and secure fixtures in place with wall carriers and bolts.
- DD. Seal fixtures to wall and floor surfaces with Silicone sealant as to match fixture.
- EE. Install all handicapped fixtures per ANSI A117.1-1986.
- FF. Assemble all fixtures and equipment shipped loose which this Contractor is required to make final connections to, whether furnished by him or by others (i.e., science cabinet water faucets, trim, or tailpiece, etc.).
- GG. Provide a premanufactured drain insulating cover on all sinks and lavatories designated as a handicap fixture. Refer to plumbing drawings and the Architect's drawings for designation.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

- E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING AND CLEANING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Install fresh batteries in sensor-operated mechanisms.
- E. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- F. At completion clean plumbing fixtures and equipment.
- G. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- H. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- I. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.6 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

3.7 FIXTURE ROUGH-IN-SCHEDULE

- A. Rough-in fixture piping connections in accordance with table of minimum sizes for particular fixtures shown with fixture schedule. (Refer to drawings.)

*** END OF SECTION 22 40 00 ***

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. HVAC demolition.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Painting and finishing.
 - 9. Concrete bases.
 - 10. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Mechanical sleeve seals.

B. Welding certificates.

C. Submit Manufacturer's published technical data, catalog cuts, wiring diagrams, shop drawings, samples and testing and balancing logs for all elements of the HVAC work. Submit under provisions of General Conditions and Supplementary General Conditions.

D. No equipment, piping, ductwork or components shall be fabricated, delivered, erected, or connected other than from shop drawings reviewed and approved by the Engineer.

E. It shall be understood that review of shop drawings by the Engineer does not supersede the requirement to provide a complete and functioning system in compliance with the Contract Documents.

F. Equipment Supports: Submit detailed shop drawings indicating equipment weight and dimensions, support material, connections, anchoring, and vibration isolation.

G. Submittals shall include, but not be limited to the following:

1. All equipment; cooling, heating, plumbing, electrical motors, starters, controls, etc.
2. Voltage, phase, and amps of each electrical item, such as motors, etc.
3. All auxiliary equipment.
4. Pipe, ductwork, valves, insulation, etc.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.8 INTENT

- A. It is the intention of these specifications and drawings to call for finished work, tested, and ready for operation. Wherever the word "provide" is used, it shall mean "furnish and install complete and ready for use."
- B. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.

- C. The term "Basis of Design" used throughout this document shall be understood to mean a particular manufacturer's equipment (as scheduled specifically on the drawings or specifications) has been used as the basis by the Design Engineer to establish physical dimensions, quality, and performance required, in addition to providing a basis for interaction with other ancillary components and/or other trades. Therefore, it shall be understood that use of a piece of equipment other than that identified as the Basis of Design may impact performance of an overall engineered system or may require revisions to ancillary interfacing equipment, and thus any manufacturer's equipment other than that listed as Basis of Design shall require written approval via Addendum prior to bid except where the manufacturer's name is specifically listed in these specifications as a pre-approved substitute or an accepted manufacturer. All substitutes, pre-approved substitutes, accepted manufacturers, and/or Basis of Design are subject to all requirements of quality, physical characteristics (i.e., dimension, sound, etc), and performance, etc., as set forth in these specifications and contract documents.

1.9 SUBSTITUTIONS

- A. Materials and equipment are specified herein by a single or by multiple Manufacturers to indicate quality and performance required. The drawings are based upon equipment scheduled on drawings and specified. If another Manufacturer is considered for substitution during the bidding process, the Mechanical Contractor shall be responsible for coordinating all electrical, mechanical, structural, or architectural changes. Comparable equipment Manufacturers which are listed below equipment indicated as "Basis of Design" shall be considered as substitutes. Manufacturers other than the Basis of Design shall submit catalog information and 1/4" scale plan and section drawings showing proper fit and all clearances for maintenance items.
- B. Substitutions of other Manufacturer's will be considered for use if, in the Engineers opinion, the item requested for substitution is equal to that specified. The Contractor shall provide to the Engineer a typed comparative list of the basis of design and the proposed substitute. The comparative shall list capacities, pressure drops, horse power, electrical requirements, etc., (refer to Submittal requirements).
- C. Request for approval of substitutions shall be made in writing no less than ten days (unless otherwise directed in Division 01) prior to bid. Substitutions shall not be considered approved unless the approval appears in an Addendum or unless so named in the specifications as a pre-approved substitute. The approval of any substitutions or equals prior to bid shall not be construed as a shop drawing approval. The substitute or equal must be submitted as described in the specifications and meet all the requirements of the specifications and drawings.
- D. All requests for substitutions shall specifically indicate any and all differences or omissions between the product specified as basis of design and the product proposed for substitution. Differences shall include, but shall not be limited to, data as follows for both the specified and substituted products.
1. Principle of operation;
 2. Materials of construction or finishes;
 3. Thickness or gauge of materials;
 4. Weight of item;
 5. Deleted features or items;

6. Added features or items;
 7. Changes in other Contractor's work caused by the substitution;
 8. Physical dimensions;
 9. Electrical requirements.
- E. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawing, which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical or electrical, all such redesign, and all new drawings and detailing required therefore, shall be prepared by the Subcontractor at his own expense and submitted to the Architect/Engineer for approval.
- F. Where such approved deviation requires quantity and arrangement of ductwork, piping, wiring, conduit, and equipment from that specified or indicated on the drawings, the Contractor shall furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

1.10 COOPERATION WITH OTHER TRADES

- A. Give full cooperation to other trades and furnish in writing to the General Contractor, with copies to the Architect, any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- B. When work installed under this Division will be in close proximity to, or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer/Architect, prepare composite working drawings and sections at a suitable scale not less than $1/4" = 1'0"$, clearly showing how work is to be installed in relation to the work of other trades. If the work is installed before coordinating with other trades, or so as to cause any interference with work of other trades, make all the necessary changes in work to correct the condition without extra charge.
- C. Furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC or PVC (as required) one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Thompson Plastics, Inc.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC or PVC (as required) four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.

- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 PIPING SYSTEMS—COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping 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 to permit valve servicing.
- E. Install piping free of sags and bends.
- F. Install fittings for changes in direction and branch connections.
- G. Select system components with pressure rating equal to or greater than system operating pressure.
- H. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

- d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- I. Install piping to allow application of insulation.
- J. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

- M. Verify final equipment locations for roughing-in.
- N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 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.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION—COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

*** END OF SECTION 23 05 00 ***

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on AC power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

1.4 WARRANTY

- A. Provide five year manufacturer's warranty under provisions of Division 1.

PART 2 PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:
 1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 EXECUTION

NOT APPLICABLE

*** END OF SECTION 23 05 13 ***

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SECTION 23 05 23 - GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. High-performance butterfly valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Iron, center-guided swing check valves.
8. Iron, plate-type check valves.
9. Chainwheels.

- B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts.

1.7 WARRANTY

- A. Provide five year manufacturer's warranty for meters and gauges under provisions of Division 1.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 2. Handlever: For quarter-turn valves.

3. Handwheel: For valves other than quarter-turn types.
 4. Handlever: For quarter-turn valves NPS 6 and smaller.
 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2.5-inch stem extensions and the following features:
1. Butterfly Valves: With extended neck.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Three piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.

- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Jenkins Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.4 HIGH PERFORMANCE BUTTERFLY VALVES—BELOW GROUND SERVICE

- A. 10" through 24": 150 psi tight-closing , rubber seated type conforming to the design standards of ANSI/AWWA C504. Valves shall be bubble tight at the rated pressure in either direction and shall be suitable for throttling service and/or operation after long periods of inactivity in buried soil and/or submerged up to 10 feet below water.
- B. Manufacturer shall have manufactured this product and have proof of satisfactory installed history for a minimum of five years and show proof of compliance with ANSI/AWWA C504. All valves shall be hydrostatic and leak tested in accordance with ANSI/AWWA C504.
- C. Valve body shall be constructed of cast iron ASTM A126, Class B, with ANSI B16.1 drilled flange. Disc shall be concentric design with ductile iron ASTM A536, Grade 65-45-12 with 316 stainless edge. Shaft shall be one piece through shaft of 18-8 stainless steel,

corresponding to the requirements of AWWA C504, latest revision, and shall be fastened by a threaded disc pin and provide a positive leak proof connection of the shaft to the disc. Shaft bearings shall be of the self-lubricating, corrosion-resistant, sleeve type and be designed for horizontal and/or vertical shaft load. Packing shall be self adjusting and suitable for vacuum or pressure service.

- D. Valve seats shall be located in the body only and shall be of a synthetic rubber compound suitable for the service and shall be designed so that no adjustments or maintenance is required.
- E. Valves shall be coated per AWWA C550 and in full compliance with NSF-61.
- F. Provide gear operators furnished with AWWA 2 inch nut and sealed housing designed for buried and submerged service for depths up to 10 feet below water for valves over 6 inches. Provide buried extension shaft with AWWA nut, removable cover, and buried shaft cover and 1 inch extension shafts as necessary for the buried/submerged depth (up to 10 feet) of the valve operator. Contractor to cut shaft and provide buried shaft cover as necessary. Provide two t-handle valve wrenches for the project. Refer also to valve box detail on the drawings for further requirements.

2.5 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.6 BRONZE SWING CHECK VALVES

- A. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.7 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Renewable Metal Seats and Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.

2.8 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Globe, Center-Guided Silent Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. APCO Willamette Valve and Primer Corporation.
 - c. Crispin Valve.
 - d. DFT Inc.
 - e. GA Industries, Inc.
 - f. Hammond Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Sure Flow Equipment Inc.
 - j. Val-Matic Valve & Manufacturing Corp.
2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron.

- e. Style: Globe, S.S. spring loaded.
- f. Ends: Flanged.
- g. Seat: Buna-N Bonded to Bronze.

2.9 IRON, PLATE-TYPE CHECK VALVES

A. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. Val-Matic Valve & Manufacturing Corp.
- 2. Description:
 - a. Standard: API 594.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 250 psig.
 - d. Body Design: Wafer, spring-loaded plates.
 - e. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - f. Seat: Bronze.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball and butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, or butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service except Steam: ball, or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/ and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valve, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
4. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Copper Pipe NPS 2 and Smaller:

1. Ball Valves: Two or Three piece, full port, brass with stainless-steel trim.
2. Bronze Swing Check Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
2. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, aluminum-bronze disc.
3. High-Performance Butterfly Valves: Class 150, single flange.
4. Iron Swing Check Valves: Class 250, nonmetallic-to-metal seats.
5. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring or iron.
6. Iron, Center-Guided Check Valves: Class 150, globe, metal seat.
7. Iron, Plate-Type Check Valves: Class 150; dual plate; metal seat.

*** END OF SECTION 23 05 23 ***

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Pipe, Duct, and Equipment Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Sleeves and Seals.
- D. Flashing and Sealing Equipment and Pipe Stacks.

1.2 RELATED WORK

- A. Section 23 05 00..... Common Work Results for HVAC.
- B. Section 23 07 00..... HVAC Insulation.
- C. Section 23 21 13..... Hydronic Piping.
- C. Section 23 23 00..... Refrigerant Piping.
- D. Section 23 31 13..... Metal Ducts.
- E. Section 23 34 23..... HVAC Power Ventilators.
- F. Section 23 36 00..... Air Terminal Units.
- G. Section 23 81 26..... Split System Air Conditioners.
- H. Section 23 82 39..... Electric Duct Heaters.

1.3 SPECIAL REQUIREMENTS

- A. Contractor shall submit shop drawings on products and methods of pipe supports.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. B-Line Systems.
- B. Grinnell.
- C. F and S.

2.2 PIPE AND DUCT HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 2 Inch: Carbon steel, adjustable swivel, split ring (copper plated for copper pipe, hot dipped galvanized coating on non-copper pipe).
- B. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
- C. Vertical Support: Steel riser clamp (at each floor).
- D. Floor Support for Pipe Sizes to 4 Inches and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- E. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- F. Shield for Insulated Piping 2 Inches and Smaller: 18 gage galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.
- G. Shield for Insulated Piping 2-1/2 Inches and Larger (Except Cold Water Piping): Pipe covering protective saddles.
- H. Shields for Vertical Copper Pipe Risers: Sheet lead.
- I. Offset Pipe Clamp: Carbon steel, hot dipped galvanized finish (copper plated for copper pipe) for supporting vertical pipe away from wall.
- J. Refer to drawings for additional supports.

2.3 HANGER RODS

- A. Hanger Rods: Threaded both ends, threaded one end, or continuous threaded. Hanger rods shall be zinc plated steel.

2.4 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.5 FLASHING

- A. Metal Flashing: 22 gage galvanized steel.
- B. Lead Flashing: 5 lb/sq.ft. sheet lead for waterproofing; one lb/sq.ft. sheet lead for soundproofing.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

2.6 SLEEVES

The following are the minimum acceptable requirements for this project. Refer to the plans for more stringent methods and requirements.

- A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gage galvanized steel, unless otherwise directed on the drawings with a more stringent requirement.

- B. Sleeves for Pipes through Non-fire Walls or Footings. Form with steel pipe or 18 gage galvanized steel, unless otherwise directed on the drawings with a more stringent requirement.
- C. Sleeves through outside walls shall be made with 18 gauge galvanized steel and fitted with chrome escutcheon covers at all finished surfaces.
- D. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL Listed. Contractor shall submit manufacturer's UL approved methods for firesafing all types required for the project as coordinated with the methods of floor and wall construction. Refer to the plans for further requirements.
- E. Sleeves for Round Ductwork: Form with galvanized steel.
- F. Sleeves for Rectangular Ductwork: Form with galvanized steel.
- G. Caulk: Silicone sealant of top quality.

2.7 FABRICATION

- A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- B. Design hangers without disengagement of supported pipe.
- C. Provide copper plated hangers and supports for copper piping.

2.8 MATERIAL/FINISH

- A. General Locations: Steel pipe hangers, miscellaneous steel supports, hardware, bolts, washers, nuts, screws, etc., not specified to be plated or coated shall be hot dipped galvanized with a minimum of 1.50 oz/ft. on all sides and all field cuts shall be zinc coated.

PART 3 EXECUTION

3.1 INSERTS

- A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

3.2 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

PIPE SIZE (INCHES)	MAXIMUM HANGER SPACING	HANGER ROD DIAMETER
1/2 to 1-1/4	6'-6"	3/8"
1-1/2 to 2	9'-0"	3/8"
2-1/2 to 3	10'-0"	1/2"
4 to 6	10'-0"	3/4"
8 to 12	14'-0"	7/8"
14 to 18	20'-0"	1"
PVC (All Sizes)	4'-0"	3/8"

- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place a hanger within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor and support from wall midway between ceiling and floor or at 12 feet maximum spacing, whichever is less. Support vertical cast iron pipe at each floor and at each hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. All auxiliary steel required for pipe supports shall be furnished and installed by this Contractor. Where building structure is not usable for pipe supports, provide steel members, channels, angles, or "UNISTRUT" components for piping support. All auxiliary steel exposed to weather shall be galvanized.
- J. Provide all steel required for support of pipes other than steel shown on structural Engineer's drawings.

3.3 EQUIPMENT BASES AND SUPPORTS

- A. Provide equipment bases and supports of concrete type under all mechanical equipment and as shown on drawings.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.4 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash and seal.
- C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with Manufacturer's instructions for sound control.

3.5 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.
- C. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk seal. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- D. Install chrome plated steel escutcheons at finished surfaces.
- E. Sleeves installed in exterior walls with exposed ends shall be non-corrosive type sleeves (i.e., stainless steel).

*** END OF SECTION 23 05 29 ***

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SECTION 23 05 48 - VIBRATION AND WIND RESTRAINT CONTROLS FOR HVAC PIPING
AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Elastomeric hangers.
 - 3. Spring hangers.
 - 4. Pipe riser resilient supports.
 - 5. Resilient pipe guides.
 - 6. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: Refer to Structural Drawings.
 - 2. Building Classification Category: Refer to Structural Drawings.
 - 3. Refer to structural drawings for minimum load requirements.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

- B. Delegated-Design Submittal: Equipment mounted outdoors shall comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation wind forces required to select wind restraints.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 - 2. Riser Supports for Building Hot Water Heating Piping: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. HVAC Pumps Located on floor level other than grade level: Provide Vibration Isolation Base Details with detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - 4. Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during wind events. Indicate association with vibration isolation devices.
 - c. Coordinate wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Welding certificates.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Isolation Technology, Inc.
 - 3. Kinetics Noise Control.
 - 4. Mason Industries.
 - 5. Vibration Eliminator Co., Inc.
 - 6. AVNEC Incorporated.
 - 7. Kevflex.
- B. Isolation Pads—A double deflection pad-type mounting consisting of two layers of 3/8" thick ribbed or waffled Neoprene pads bonded to a 16 gage galvanized steel separator plate. Pads shall be sized for approximately 20 to 40 psi load and a deflection of 0.12" to 0.16".
- C. 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.
- D. 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.

- E. Flanged Pump Piping Isolator, spherical rubber expansion joint constructed of molded neoprene, nylon cord reinforced, with integral steel floating flanges, suitable for pressure up to 225# (4 to 1 safety factor) and temperatures up to 225°F. Connectors shall have minimum movement capability of 1/2" compression, 3/8" extension 1/2" lateral and 15° angular. Where allowable movements will be exceeded or where operating pressures exceed the following, control rods shall be installed at each connector to limit elongation to 3/8".

through 4".....	200 psi
5" to 10".....	150 psi
12" to 14".....	100 psi
16" to 24".....	50 psi

Control units shall be of the spring isolated design through 8" and neoprene isolated for 10" and larger to limit noise and vibration transmission through the control rods.

- F. Pipe Riser Resilient Support All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- G. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Isolation Technology, Inc.
 4. Kinetics Noise Control.
 5. Mason Industries.
 6. Vibration Eliminator Co., Inc.
 7. Vibration Isolation.
 8. Vibration Mountings & Controls, Inc.

- B. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - b. Provide Spring Isolators on Piping Connected to Isolated Equipment as follows: Up to 4 inch diameter, first three points of support; 5 to 8 inch diameter, first four points of support; 10 inch diameter and over, first six points of support. Static deflection of first point shall be twice deflection of isolated equipment.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 - 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 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 and wind-control devices to indicate capacity range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and wind-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. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

3.3 VIBRATION-CONTROL AND WIND-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install wind restraints on outdoor HVAC equipment.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install wind-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

3.4 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust active height of spring isolators.
- C. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.5 HVAC VIBRATION-CONTROL DEVICE SCHEDULE

- A. Supported or Suspended Equipment: Install vibration isolators and flexible connectors for the following motor driven equipment.
 - 1. Pumps: Flanged Pump Piping Isolator (mount on suction and discharge side of pump piping).
 - 2. Chillers, Cooling Towers, Condensing Units, and Chilled Water Air Handling Units: Neoprene Isolation Pads.
 - 3. Suspended Split System Air Handling Units and Power Ventilators: Elastomeric or Spring Hangers.

*** END OF SECTION 23 05 48 ***

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.

1.3 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. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. 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.
4. Fasteners: Stainless-steel rivets.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2 by 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.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), 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.
- B. Letter Color: White.
- 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 by 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.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive. Colors shall comply with ANSI A13.1. Size markers and letters as follows:

OUTSIDE DIAMETER OF INSULATION OR PIPE	LENGTH OF COLOR FIELD	SIZE OF LETTERS
3/4" - 2"	1" x 8"	3/4"
2 1/2" - 6"	2 1/4" x 13"	1 3/4"
8" - 10"	4" x 24"	2 1/2"
Over 10"	4" x 32"	3 1/2"
Ductwork and Equipment	All	3 1/2"

- C. 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: White.
- C. Background Color: Black.
- 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 by 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.
- 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 VALVE TAGS

- A. Valve Tags: 1-1/2 inch diameter, 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.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.

2. Fasteners: Reinforced grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.
- C. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic equipment markers. Small devices, such as in-line pumps, may be identified with metal tags.

3.3 PIPE LABEL INSTALLATION

- A. 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 20 feet along each run including risers and drops, adjacent to each valve and "T", at each side of penetration of structure or enclosure, and at each obstruction.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
 8. Tags may be used on small diameter piping.

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.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels at air handlers, 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. Identify as to air handling unit number and service (supply air , return air, exhaust, outside air, etc.).

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. Provide a valve chart and schedule in aluminum frame with clear plastic shield. Install at location as directed.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 EQUIPMENT LOCATOR TACK

- A. Equipment Located Above Ceiling (i.e., VAV boxes, fans, air handlers, fire dampers, smoke dampers, etc.): Provide equipment locator tack, located on the ceiling directly below the equipment, to be spot marked and so mark is easily visible from the floor. Use a permanent marker and label each tag with the name of the equipment. Color code equipment by type as follows:

EQUIPMENT ABOVE CEILING	COLOR
Air Handlers/Fan Coil Units	Light Blue
Exhaust Fans	Green
VAV Boxes	Yellow
Duct Heaters	Orange
Fire Dampers	Red
Smoke Dampers	Red

- B. Ductwork Volume Dampers Above the Ceiling: Tie an orange tape flag, minimum 18" long, from each volume damper. Let tape hang down vertically.

*** END OF SECTION 23 05 53 ***

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SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

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. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

- A. LEED Submittal:
 - 1. Air-Balance Report for LEEDPrerequisiteEQ1: Documentation of work performed for ASHRAE62.1, Section7.2.2, "Air Balancing."
- B. Qualification Data: Within 30 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.
- C. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part3.
- D. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

- E. Certified TAB reports.
- F. Sample report forms.
- G. 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.
- H. The test and balance firm will submit two (2) copies of data for the testing and balancing for the approval of the Project Architect/Engineer and three (3) file copies to the Owner and two (2) copies to this Contractor.
- I. All data and information shall be compiled in a neat, orderly format on 8-1/2" x 11" test forms and shall be signed and sealed by the certified individual as previously described.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.
- B. TAB Conference: Meet with Contractor on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

- D. TAB Report Forms: Use standard TAB contractor's forms approved by Owner. Written report submitted to the Engineer a minimum of 15 days prior to Substantial Completion of each project phase. The Owner will then perform a verification TAB. If discrepancies are found, they will be corrected by this Contractor and the contractor will be responsible to pay for additional trips for the Owner's TAB representatives to verify.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE111, Section 5, "Instrumentation." All instruments used shall be accurately calibrated within six months of testing and balancing and shall be maintained in good working order.
- F. The final result of balancing shall be to provide uniform air temperatures within a two (2) degree F spread in the conditioned space at peak load conditions.
- G. In the event of dispute, the Owner or Contractor or Project Architect/Engineer may choose to provide verification of test and balance reports, and such verification shall be by a second independent agency selected by the Engineer. Reports found to be inaccurate will be disallowed, and the Contractor's test and balance firm will be required to repeat operations under the supervision of the second independent agency until accurate reports are completed and agreed upon, provided the Contractor's TAB firm is found to be at fault in the judgment of the Engineer. The cost of disputed test and balance work shall be borne by the Owner or Contractor (whichever is found to be at fault).

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. 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.

1.8 SCOPE

- A. Description
 - 1. The Contractor shall, at the Contractor's expense, procure the services of an independent testing and balance firm which specializes in the balancing and testing of heating, ventilating and air conditioning systems. This specialty services firm shall balance, adjust and test water circulation, air moving equipment, air distribution and/or exhaust systems as herein specified.
 - 2. Test and balance work shall not begin until all systems have been completed and are in full working order to the satisfaction of the Project Architect/Engineer and the Owner. This Contractor shall make all preliminary tests and adjustments before advising in writing that test and balance work is ready to begin and shall place all systems and equipment into full operation during each working day of testing and balancing.

- B. Replacement pulleys (adjustable and non-adjustable), additional balancing dampers, pressure taps, balancing valves, cocks and fittings, etc., required to effect proper air and water balance shall be furnished and installed by this Contractor at no additional cost to the Owner. This Contractor shall do this work as soon as possible so as not to delay the completion of the test and balance work.
- C. Air filters shall be replaced and strainers shall be cleaned by this Contractor before proceeding with test and balance and thereafter as required by the test and balance firm.
- D. Systems shall be placed into service using approved start up procedures. This (mechanical) contractor shall be responsible for proper initial setting and adjustment of HVAC equipment, air handlers, VAV boxes, exhaust fans, etc. furnished and installed by him.
- E. This Contractor shall provide test openings as required; shall operate HVAC equipment and provide trades persons to assist and make adjustments for test and balance during the process.
- F. When the Owner's verification test and balance firm is ready to test according to the established schedule, but is prevented from testing and balancing, making adjustments or taking measurements due to incompleteness of the work, all extra charges for test and balance attributable to the delay may be back charged to this Contractor. The Project Architect/Engineer shall be the judge as to whether a delay has occurred and back charges due the Owner, and which, if judged proper, shall be effected through a Change Order reducing the Contract Sum.
- G. The Contractor's test and balance firm shall periodically visit the site during construction of the HVAC system. No less than two visits per phase will be made. Should methods, materials or workmanship being used adversely affect balancing and adjusting work, the test and balance agency shall report its findings in writing to the Contractor with recommendations for correction.
- H. The Contractor's test and balance firm has agreed or shall agree to carry out the test and balance in accordance with the AABC National Standards for Total Systems Balance or the NEBB Procedural Standards for Testing, Adjusting and Balancing or Environmental Systems, Fourth edition, and in conformance with ASHRAE Handbook, Chapter 34, Testing, Adjusting and Balancing and as outlined in this Specification Section.
- I. This Contractor shall furnish to the testing and balancing agency a complete set of plans and specifications, addenda, shop drawings, schedules and change orders as may be required.

PART 2 PRODUCTS

(NOT APPLICABLE)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine 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 ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Ductwork" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. 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.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

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 AABC's "National Standards for Total System Balance," NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
 - 1. Comply with requirements in ASHRAE62.1, Section7.2.2, "Air Balancing."
- 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. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC 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 Division 23 Section "Ductwork."

3.5 BUILDING PRESSURIZATION TESTING AND BALANCING

- A. This Contractor shall measure the building static pressure relative to the outdoor static pressure (differential pressure measurement) and balance each air delivery system (system) to obtain 0.03 inches of water column positive pressure within that portion of the building with all exterior openings (doors and windows) closed.
- B. This Contractor shall make preliminary field differential pressure measurements of the building upon completion of the initial testing and balancing of the entire building or buildings HVAC systems. This shall be accomplished once the air delivery systems have been fully tested and balanced to within 10 percent of the scheduled air flow rates per the Contract Documents. A preliminary test and balance report (hand written copies are satisfactory) shall be submitted to the Engineer of Record at this point in the project. Based upon the initial building differential pressure measurements, the Contractor shall proceed with the Building Pressurization Testing and Balancing final field adjustments. If there are any questions regarding the building pressurization testing and balancing requirements, the Contractor should contact the Engineer and clarify the intended process prior to making the final field adjustments.

- C. This Contractor shall review the drawings and ventilation schedule for each system to determine whether the system ventilation outside air flow rate is determined by the number of occupants "people" or determined by the minimum exhaust "exhaust" requirements. If the ventilation outside air is determined by "people", this contractor shall adjust the building pressure by readjusting the relief fan volumetric flow rate for that system as directed by the Engineer. If the ventilation outside air is determined by "exhaust", the building pressure shall be revised by adjusting the volumetric flow rate of outside air for that system as directed by the Engineer. Where the system design employs the use of barometric dampers in addition to or in lieu of relief fans for building pressurization control, the Contractor shall also adjust the barometric damper to obtain the stated building pressure.
- D. In either building pressurization balancing adjustment scenario, the ventilation rate shall not be reduced below the minimum required ventilation flow rate as determined by AHRAE 62.1 and represented on the Ventilation Schedule.
- E. This Contractor shall document the final building pressurization measurements as a basic part of the test and balance report. The building pressurization measurement data and balancing methodology shall be presented in the report for each system. This shall include a narrative describing the method that was used to adjust each system, and the location of each reported differential pressure measurement.

3.6 SOUND TESTING

- A. Using approved instruments, the test and balance firm shall conduct tests in selected areas of the building as specified below. Sound level readings shall be measured in decibels on the "A" and "C" scales of the General Radio Company sound level meter, or equal sound level meter that meets the current American Standards (224.3-1944) based on the acoustic reference power of D.B./RE 10.13 watts. Readings shall set forth the total random sound level of the selected rooms or areas with the system in operation, as compared to total background sound level with the system not in operation. The system increase over the background level shall be recorded in decibels on the "A" and "C" scales. If sound levels are above those listed below, adjustments shall be made by this Contractor to bring the sound level within the range set forth. If this cannot be done with the equipment as installed, recommendations shall be made by the test and balance firm to correct the sound level to within the specified range. Additions of sound traps, insulation, or dampers shall be made by this Contractor under the direction of the balance agency at no additional cost to the Owner, provided the noise is due to Contractor's fault. Sound level readings (in decibels) shall be taken at each diffuser, grille or register in occupied areas. The sound levels shall be approximately 45 degrees to the center of the diffuser, etc., on the "A" and "C" scales of a General Radio Company sound level meter. The computed equivalent sound level meter readings weighting scale "A" (DBA) shall not exceed 40 for general office type space, 35 for classroom and conference room type space and 30 for sensitive areas such as libraries or auditoriums.
- B. Sound measurements shall be taken in the following locations:
 - 1. A typical bunk room remote from mechanical equipment rooms.
 - 2. A typical occupied space adjacent to mechanical equipment room.
 - 3. Typical offices.
 - 4. Special assembly rooms such as conference room.

- C. When a typical space (1, 2, or 3 above) has been tested and passed, all such spaces shall be considered complying. Conversely, if a typical space fails, all such spaces shall be considered as failed and require testing.
- D. Unless test results indicate failure to comply with the intention of these Specifications, sound testing shall be done only once, preferably during cooling season.
- E. Sound levels at maximum rates shall be listed on the TAB report on a point measured basis as required above.

3.7 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 Owner and Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 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.

3.8 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.

3.9 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. Close all bypass valves. Set modulating valve to full coil 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.
9. Check all strainers and, if required, clean same.
10. Examine water in system and determine if water has been treated and cleaned. If water appears dirty, test and balance work shall stop and this Contractor shall reclean system as specified in the Project Specifications.
11. Check all air vents at high points of water system and determine if all are installed and operating freely. Make sure all air is removed from the system.
12. Set all temperature controls so all coils are calling for full cooling, and determine that this closes all automatic by-pass valves at coils.
13. Check operation of automatic by-pass valves.
14. Check and set operating temperatures of chillers and heat exchangers to design requirements.
15. Complete air balance work must have been accomplished and all work adjusted and corrected before actual water balance is complete.

3.10 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, turn these dimensions, along with the installed pump curves with the new pump and system curves, for review by the Engineer. Upon approval by the Engineer, the impeller dimensions shall be turned over to the installing contractor for impeller shaving.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 10 percent of design.

- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.11 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.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 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.

3.12 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.13 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.14 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.

3.15 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 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.
 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.16 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.17 FINAL 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.
 - 8. Report date.
 - 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. Settings for supply-air, static-pressure controller.
 - g. 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.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
 1. Unit Data:
 - a. Unit identification.

- b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. 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.
 - m. Vortex damper position.
- F. Apparatus-Coil Test Reports:
- 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 degF.
 - e. Return-air, wet- and dry-bulb temperatures in degF.
 - f. Entering-air, wet- and dry-bulb temperatures in degF.
 - g. Leaving-air, wet- and dry-bulb temperatures in degF.
 - h. Water flow rate in gpm.
 - i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in degF.
 - k. Leaving-water temperature in degF.
 - l. Refrigerant expansion valve and refrigerant types.

- m. Refrigerant suction pressure in psig.
 - n. Refrigerant suction temperature in degF.
 - o. Inlet steam pressure in psig.
- G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, 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 degF.
 - e. Leaving-air temperature in degF.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- H. 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.
- I. 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 degF.
 - 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.
- J. 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 degF.
- K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
- 1. Unit Data:
 - a. System and air-handling-unit identification.

- b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
- 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Entering-water temperature in degF.
 - c. Leaving-water temperature in degF.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in degF.
 - f. Leaving-air temperature in degF.
- 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.

3.18 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 5 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. Prepare test and inspection reports.

3.19 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.

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SECTION 23 07 00 - HVAC INSULATION

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. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Lagging adhesives.
 - 6. Sealants.
 - 7. Field-applied fabric-reinforcing mesh.
 - 8. Field-applied cloths.
 - 9. Field-applied jackets.
 - 10. Tapes.
 - 11. Securements.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at pipe expansion joints for each type of insulation.

3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Detail removable insulation at piping specialties, equipment connections, and access panels.
5. Detail application of field-applied jackets.
6. Detail application at linkages of control devices.
7. Detail field application for each equipment type.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in piping insulation application with three (3) years minimum experience.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting 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.

1.5 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.

1.6 COORDINATION

- A. Coordinate size and location 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, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation prior to operating to operating system. Do not use wet insulation materials or apply insulation to wet surfaces.

PART 2 PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 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. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Block Insulation: ASTM C 552, Type I.
 - 2. Special-Shaped Insulation: ASTM C 552, Type III.
 - 3. Board Insulation: ASTM C 552, Type IV.
 - 4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- H. Type A Piping Insulation:
 - 1. Impermeable, noncombustible, closed cellular glass insulation, conforming to ASTM C 552-79, "Specification for Cellular Glass Block and Pipe Thermal Insulation."
 - 2. Conductivity (k) equals approximately 0.29 (BTU-IN/HR, SF, degrees F) at 75 degrees F.
 - 3. Joint sealants and coatings shall be as approved by the insulation manufacturer for the intended application and service temperature range.
 - 4. Jacketing shall be approximately 125 mils thick, consisting of a bituminous resin reinforced with a woven, glass fabric, an integral aluminum foil layer, and a protective plastic film coating.

5. Approved Manufacturers and trade names:
 - a. Pittsburgh Corning Corp. *"Foamglass Super K"* with Pittseal, Pittcote, and Pittwrap.
 - b. Approved Equal.
- I. Type B Piping Insulation:
 1. Closed cell, flexible foamed plastic conforming to ASTM C177 or ASTM C518, "Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form."
 2. Conductivity (k) equals approximately 0.27 (BTU-IN/HR, SF, Degree F) at 75 degrees F.
 3. Approved Manufacturers and trade names:
 - a. Armstrong *"AP Armaflex"*
 - b. Rubetex Corp. *"Rubetex"*
- J. Type C Piping Insulation:
 1. Glass fiber, rigid molded sectional pipe covering conforming to ASTM C547, Class II, Mineral Fiber Preformed Pipe Insulation.
 2. Conductivity (k) equals approximately 0.23 (BTU-IN/HR, SF, Degree F) at 75 degrees F.
 3. Approved Manufacturers and Trade Names:
 - a. Manville Corp. *"Micro-Lok 650-AP-T."*
 - b. Owens-Corning Fiberglass Corp. *"One Piece 25 ASJ/SSL-II"*
 - c. Certain-Teed *"500 Degree Snap-On."*
 - d. Knauf Fiberglass *"Knauf Pipe Insulation, 850°F."*
- K. Type A-D Duct Insulation:
 1. Flexible glass fiber; ANSI/ASTM C553; commercial grade; 6.0 installed 'R' value (minimum) at 75 degrees F, 0.002 foil scrim facing for air conditioning ducts (nominally 2" thick).
- L. Type B-D Insulation:
 1. Glass fiber; UL Class 1; 'k' value of 0.24 at 75 degrees F 3 lb/cu ft minimum density; black pigmented, fire resistant coated air side for maximum 6,000 ft/min air velocity. Insulation shall be Owens-Corning Fiberglass Aeroflex Duct Liner.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Super Firetemp M.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
 - d. Thermal Ceramics; FireMaster Duct Wrap.
 - e. 3M; Fire Barrier Wrap Products.
 - f. Unifrax Corporation; FyreWrap.
 - g. Vesuvius; PYROSCAT FP FASTR Duct Wrap.

2.3 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
- C. Mineral-fiber, hydraulic-setting cement is suitable for temperatures from 100 to 1200 deg F (38 to 649 deg C) and for a smooth surface.

- D. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.4 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. Cellular-Glass, Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Products, Division of ITW; CP-96. (-20 to 180)
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.

- e. Mon-Eco Industries, Inc.; 22-25.
- 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - 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 and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Products Corporation, H. B. Fuller Company; 30-65.
 - b. ITW TACC, Division of Illinois Tool Works; CB-50.

- c. Marathon Industries, Inc.; 590.
 - d. Mon-Eco Industries, Inc.; 55-40.
 - e. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, 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, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-9.
 - b. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - c. Marathon Industries, Inc.; 550.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.6 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
- 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 one of the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.

- e. Vimasco Corporation; 136.
- 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
- 4. Service Temperature Range: Minus 50 to plus 180 deg F.
- 5. Color: White.

2.7 SEALANTS

A. Joint Sealants:

- 1. Joint Sealants for Cellular-Glass: Subject to compliance with requirements, provide one of the following:
- 2. Childers Products, Division of ITW; CP-76.
 - a. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - b. Marathon Industries, Inc.; 405.
 - c. Mon-Eco Industries, Inc.; 44-05.
 - d. Pittsburgh Corning Corporation; Pittseal 444.
 - e. Vimasco Corporation; 750.
- 3. Materials shall be compatible with insulation materials, jackets, and substrates.
- 4. Permanently flexible, elastomeric sealant.
- 5. Service Temperature Range: Minus 100 to plus 300 deg F.
- 6. Color: White or gray.
- 7. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

- 1. Products: Subject to compliance with requirements, provide one of the following:
- 2. Childers Products, Division of ITW; CP-76-8.
 - a. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - b. Marathon Industries, Inc.; 405.
 - c. Mon-Eco Industries, Inc.; 44-05.
 - d. Vimasco Corporation; 750.
- 3. Materials shall be compatible with insulation materials, jackets, and substrates.

4. Fire- and water-resistant, flexible, elastomeric sealant.
 5. Service Temperature Range: Minus 40 to plus 250 deg F.
 6. Color: Aluminum.
 7. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 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: White.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
1. Products: Subject to compliance with requirements, provide one of the following:
 2. Vimasco Corporation; Elastafab 894.
- B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 3 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
1. Products: Subject to compliance with requirements, provide one of the following:
 2. Childers Products, Division of ITW; Chil-Glas No. 5.
- C. Woven Polyester Fabric: Approximately 3 oz./sq. yd. with a thread count of 6 strands by 5.5 meshes per inch, in a Leno weave, for duct, equipment, and pipe.
1. Products: Subject to compliance with requirements, provide one of the following:
 2. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
 - a. Vimasco Corporation; Elastafab 894.
 - b. Childers Products, Division of ITW; Chil-Glas No. 10.
 - c. Pittsburgh Corning, PC Fabric 79.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: Color-code jackets based on system..
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 - 5. Factory-fabricated tank heads and tank side panels.

2.10 TAPES

- A. 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 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.
- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

- A. Bands:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
 2. Aluminum: ASTM B 209 Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
- B. Insulation Pins and Hangers:
1. 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.
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGM Industries, Inc.; CWP-1.
 - b. GEMCO; CD.
 - c. Midwest Fasteners, Inc.; CD.

- d. Nelson Stud Welding; TPA, TPC, and TPS.
3. 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
4. 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 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, 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.
5. Self-Sticking-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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.

- b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
- 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-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, available products that may be incorporated into the Work include, but are not limited to, 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.
- 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, galvanized steel.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. C & F Wire.
 - 3. Childers Products.
 - 4. PABCO Metals Corporation.
 - 5. RPR Products, Inc.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment 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. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 0 and 200 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. 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 equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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 2 inches o.c.
 - a. Provide self adhesive aluminum tape continuous along staples seams.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and 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.

- P. Overlap wrapped insulation 12 inches beyond point of lined duct connections.
- Q. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

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, vessels, and equipment. 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.

3.6 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but 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 cut sections of cellular-glass block insulation of same thickness as pipe 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. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. 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.

E. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism. Refer to drawings for details

2. Fabricate boxes from aluminum, at least 0.060 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

F. Interior Piping

1. Butter joints of Foamglass insulation with adhesive. Apply insulation to pipe and fittings with all joints tightly fitted. Secure with stainless steel wire so that each length of insulation shall be secured with two wires. Insulation shall be applied with all joints fitted to eliminate voids. Voids shall be eliminated by refitting or replacing insulation. Do not fill voids with joint sealer.
2. Finish with metalized polyester/scrim/bleached white Kraft or approved foil/scrim/bleached white Kraft, all service jacket (ASJ). Finish elbows and fittings with mastic reinforced with white open weave membrane with maximum mesh opening of 10 x 10 per inch.

G. Exterior and Mechanical Equipment/Storage Rooms Piping

1. Apply insulation as noted above and apply vapor barrier reinforced with white open weave membrane with maximum mesh opening of 10 x 10 per inch. Then apply a second coat of vapor barrier and finish with 0.016 inch thick aluminum jacket. Elbows and tees shall be finished with preformed 0.024 inch thick aluminum fitting covers.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- 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.

E. Interior Piping

1. Type B insulation shall be slipped on the pipe prior to connection, and the butt joints shall be sealed. Where the slip-on techniques is not possible, the insulation shall be carefully slit and applied to the pipe.
2. All joints shall be sealed with the Manufacturer's recommended adhesives.
3. Do not apply Type B insulation in multiple layers.
4. Type B insulation shall not be used in plenums nor fire wall penetrations.
5. This Contractor shall paint Type B insulation exterior to the building with two (2) coats of a vinyl lacquer paint recommended by the Insulation Manufacturer.

F. Exterior and Mechanical Equipment/Storage Rooms Piping

1. Type B insulation shall be installed as described for interior except the pipe and fitting shall be covered with .016 inch thick aluminum jacket.
2. Elbows and tees shall be finished with preformed 0.024 inch thick aluminum fitting covers.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. 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.
1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use tape along lap seal to secure joint.
 2. Repair holes or tears in jacket by placing tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.9 MINERAL FIBER PIPE INSULATION INSTALLATION

A. Interior—Type C Pipe Insulation

1. Tightly butt together sections of insulation on pipe runs sealing longitudinal seams of jacket with vapor barrier adhesive. Seal end joints with four inch (4") wide straps of vapor barrier tape. Seal off ends of insulation with vapor seal mastic at valves, fittings, and flanges. No further finish required.

B. Exterior and Mechanical Equipment/Storage Rooms—Type C Pipe Insulation

1. PVC fitting jackets shall be used for the particular application.

3.10 DUCT INSTALLATION

A. Type A-D Installation

1. Apply insulation tightly and smoothly to duct.
2. Secure insulation on the bottom of ducts and plenums and on the sides of plenums and other places where the insulation will sag.
3. Install all materials in accordance with Manufacturer's installation instructions.
4. Butt all insulation joints firmly.

5. Install duct wrap to obtain specified 'R' value using a maximum of 25% compression.
6. All penetrations and damage to the facing shall be repaired with tape and mastic prior to system start-up.
7. Provide 3" wide (minimum) pressure sensitive tape applied with moving pressure using an appropriate sealing tool at all seams and joints. Apply vapor seal mastic over all taped seams and joints.
8. Longitudinal seam of the vapor retarder shall be overlapped a minimum of 2 inches. A 2 inch tab shall be provided for the circumferential seam.
9. Closure systems shall have a 25/50 flame spread/smoke developed rating per UL 723.
10. For rectangular ducts over 18 inches wide, the duct wrap shall be secured to the bottom side of the duct with mechanical fasteners spaced on 18 inch centers to reduce sag. Fasteners shall be installed in a manner to avoid over compressing the insulation with the retaining washer.
11. Impale insulation on the bottom of ducts and plenums and on the sides of plenums and other places where the insulation will sag.
12. Cut off protruding pin after clips are secured and seal with aluminum backed pressure sensitive tape.
13. Apply insulation with joints tightly butted.
14. Seal all ductwork joints, punctures, and fittings with a mastic type sealant containing a vapor barrier.
15. Cover all breaks, joints, punctures, and voids with a vapor seal mastic and cover with a vapor barrier material identical to vapor barrier on the insulation.
16. Bevel insulation around nameplates, access plates, and doors.
17. Insulation shall be continuous through walls and floors except at fire dampers.

B. Type B-D Installation

1. All portions of duct designated to receive duct liner shall be completely covered with Duct Liner. Transverse joints shall be neatly butted and there shall be no interruptions or gaps. Board shall be cut to assure tight, overlapped corner joints. Top pieces shall be supported by the side pieces.
2. The black coated surface of Duct Liner shall face the air stream.
3. Duct Liner shall be adhered to the sheet metal duct with 100% coverage of adhesive, all exposed leading edges and transverse joints shall also be coated with adhesive. In addition to the above, mechanical fasteners shall be used to secure the Duct Liner to the duct. All edges of duct liner shall be coated with adhesive during the fabrication of ductwork and all exposed edges shall be coated with adhesive prior to field installation of sections.

4. For horizontal runs when the duct width exceeds 12" or the duct height exceeds 16", the Duct Liner Board shall be additionally secured with mechanical fasteners starting within 3" of upstream transverse edges of the Liner and spaced at a maximum of 15" o.c. and 15" from longitudinal joints. On vertical runs, the fasteners shall be used when either dimension exceeds 12".

- C. Install all materials in accordance with Manufacturer's installation.
- D. Continue insulation with vapor barrier through penetrations.

3.11 FIRE-RATED PENETRATIONS

- A. Install firestopping at penetrations through fire-rated assemblies.

3.12 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Owner. Vary first and second coats to allow visual inspection of the completed Work. Refer to Mechanical Identification specification.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 EQUIPMENT INSULATION SCHEDULE

- A. Chiller Cold Surfaces—Type 'B'—1" thick (add insulation to all surfaces which exhibit condensation).
- B. Heat Exchangers—Uninsulated with drip pan (unless otherwise noted in the heat exchanger specification).
- C. Air Separators, Strainers, Valve Bodies etc.—Type 'A'—2" thick.
- D. All Equipment Operating Below Ambient Dew Point—Type 'A'—2" thick.
- E. Handicap Accessible Lavatory and Sink Traps, Cold and Hot Water Supply Piping—Type 'B'—3/4" thick, unless otherwise noted on plumbing drawings.
- F. Piping system chemical shot feeder and side stream filter and interconnecting piping insulation shall be the following:
 1. Flexible elastomeric—Type B—1" thick.
- G. Thermal Storage Tank Insulation (not insulated at the factory)—Type 'A'—3" thick.

3.14 PIPING INSULATION SCHEDULE

A.

SERVICE	PIPE SIZE	INSULATION TYPE AND THICKNESS
Exterior Chilled Water (including unconditioned spaces and mechanical equipment rooms)	All	2-1/2" Type A
Interior Chilled Water (Including Domestic)	2" or Less	1-1/2" Type A
Interior Chilled Water	2-1/2" to 12"	2" Type A
Interior Chilled Water	14" and Larger	2-1/2" Type A
Chilled Water 40°F and Below	2" or Less	2-1/2" Type A
Chilled Water 40°F and Below	2-1/2" to 12"	3" Type A
Chilled Water 40°F and Below	14" and Larger	3" Type A
Refrigerant Suction Pipes (except in plenums or fire wall penetrations)	All	3/4" Type B
Refrigerant Suction Pipes and Coil Condensate Lines (in plenums or fire wall or floor penetrations)	1-1/4" or Less	1-1/2" Type A
Refrigerant Suction Pipes and Coil Condensate Lines (in plenums or fire wall or floor penetrations)	1-1/4" or More	1-1/2" Type A
Condensate and Equipment Drain Water Below 60°F	All	1" Type B
Heating Hot Water	All	2" Type A
Domestic Hot Water, Tempered Water, Recirculated Hot Water, and Service Hot Water	2" or Less	1" Type C
Domestic Hot Water, Tempered Water, Recirculated Hot Water, and Service Hot Water	2-1/2" or More	1-1/2" Type C
Roof Drain Bodies	All	1-1/2" Type C
Horizontal Rain Water Conductors	All	1-1/2" Type C

B. Refer to Section 23 21 13, Hydronic Piping, for description of underground piping system.

3.15 DUCT INSULATION SCHEDULE

- A. Outside Air Intake and Supply and Return Ductwork—Type A-D (nominally 2" thick).
- B. Flex Connections at Air Handling Units and Other Transitions—Type A-D (nominally 2" thick).
- C. All Equipment and Ductwork Operating Below Ambient Dew Point—Type A-D (nominally 2" thick).

- D. Central Station AHU Supply and Return Ductwork—First forty (40) feet, unless noted otherwise on the drawings, before and after air handler—Type B-D (1" thick) sandwiched inside double wall duct. Refer to Ductwork specification for more information.
- E. Supply, Return and Exhaust/Relief Ductwork—Exposed in Occupied Spaces— Type B-D (1" thick) sandwiched inside double wall duct. Refer to Ductwork specification for more information.
- F. Exhaust, Relief and Air Transfer Ductwork—Type B-D (1" thick). Round Branch runout ductwork shall be wrapped with Type A-D (nominally 2" thick).
- G. Tops of All Supply Diffusers—Type A-D (nominally 2" thick).
- H. Pre-Conditioned Outside Air—Type A-D (nominally 2" thick).
- I. Relief Air Duct Between ERV and AHU—Type B-D (1" thick) sandwiched inside double wall duct.

*** END OF SECTION 23 07 00 ***

SECTION 23 08 00 - COMMISSIONING OF HVAC SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to, and become familiar with the project's Construction Documents, and the following specifications.
 - 1. Section 23 05 93 Testing, Adjusting, And Balancing For HVAC.
 - 2. Section 23 09 00 Instrumentation And Control For HVAC

1.2 SUMMARY

- A. Commissioning is a systematic process of ensuring all building systems perform interactively according to design intent and Owner's operational needs. Commissioning will encompass and coordinate traditionally separate functions of system documentation, installation checkout, equipment Start-Up, control system calibration and point-to-point checkout, testing and balancing, and Functional Performance Testing. Commissioning is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. Verify and document proper installation and performance of equipment and systems.
 - 2. Provide Owner with functional buildings and/or systems with minimal operational problems at time of move-in.
- B. Commissioning does not take away from or reduce responsibility of system designers or installing contractors to provide a finished and fully functioning product.
- C. This section shall in no way diminish the responsibility of the Division 22, 23 and 26 Contractors, Subcontractors and Suppliers in performing all aspects of work and testing as outlined in the contract documents. The commissioning requirements outlined in this specification are separate from and in addition to any other testing or commissioning requirements in other Division specifications.
- D. The Commissioning Team will include representatives of the Owner, Design A/E, General Contractor and Installing Subcontractors, Test and Balance Subcontractor, BAS Subcontractor and Commissioning Authority (CxA).

1.2 DEFINITIONS

- A. Acceptance Phase: The phase of commissioning (typically commencing upon Substantial Completion) in which all uncompleted functional testing, training, and project documentation is finalized, and building performance is fine-tuned. Also known as "Occupancy and Operations Phase."
- B. Balancer: The specialty subcontractor engaged by the Contractor to perform Testing, Adjusting and Balancing (TAB), of air and hydronic equipment and related control devices, to ensure the HVAC system operates within specified design parameters.

- C. Commissioning Plan: A document, prepared by the CxA, which outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process. Plan shall include the following:
1. Narrative of commissioning activities to be completed.
 2. List of equipment and systems to be tested.
 3. Functions to be tested.
 4. Conditions under which tests will be performed.
 5. Measurable criteria for performance.
- D. Commissioning Team: Collectively, the group of Contractor-appointed and Owner-appointed representatives explicitly organized to implement the commissioning process through coordinated action. Individual team members each have authority to act on behalf of the entity they represent.
1. Contractor-Appointed Members:
 - a. Contractor, including Project superintendent
 - b. Subcontractors, including installers, suppliers, and any specialists deemed appropriate by the CxA.
 - c. Mechanical Subcontractor.
 - d. Test and Balance Subcontractor.
 - e. Controls Subcontractor.
 2. Owner-Appointed Members:
 - a. Architect / Engineer of Record.
 - b. Facility/Site Administrator, Operation & Maintenance Personnel.
- E. Construction Phase: The phase of commissioning (typically concurrent with construction), in which the Commissioning Team works to ensure equipment, systems, and assemblies are properly installed, integrated, and operating in a manner compliant with the Construction Documents.
- F. CxA: Certified Commissioning Authority. The designated person(s), company, or entity that plans, schedules, and coordinates the commissioning process. **The CxA shall be the Engineer of Record.**
- G. Design Phase: The phase of commissioning (typically prior to construction) in which the Design Professional's Construction Documents (plans and specifications), etc., are reviewed for consistency with one another and with the OPR.
- H. O&M: Operation and Maintenance – Can refer to either personnel or manuals

- I. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and related supporting information.
- J. Post-Acceptance Phase: The phase of commissioning (typically commencing upon Final Acceptance) in which follow-up checks are conducted to ensure equipment, systems, and assemblies continue to operate in a manner compliant with the OPR. Any deficiencies discovered during this phase are identified as warranty claims.
- K. Pre-Design Phase: The phase of commissioning (typically prior to preparation of Construction Documents) in which the Commissioning Team is assembled, and the OPR is developed. Decisions made in subsequent commissioning phases should comply with the OPR.
- L. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.3 OWNER'S RESPONSIBILITIES

- A. Assign O&M personnel and schedule them to participate in Commissioning Team activities.
- B. Provide the Construction Documents, prepared by Design Professional and approved by Owner, to the CxA and the Contractor for use in developing the commissioning plan, systems manual, and O&M training plan.

1.4 CxA QUALIFICATIONS

- A. The CxA shall be a Registered Design Professional knowledgeable in the design and operation of HVAC systems.

PART 2 GENERAL

(NOT USED)

PART 3 EXECUTION

3.1 CONSTRUCTION PHASE ACTIVITIES—DURING THIS COMMISSIONING PHASE, THE CxA SHALL:

- A. Identify all the Commissioning Team members.
- B. Schedule and conduct a "kick-off" meeting to bring all Commissioning Team members together, distribute the Commissioning Plan, identify roles for each team member; discuss the commissioning process, and review the schedule.
- C. Schedule and conduct all commissioning meetings, providing minutes and task tracking.
- D. Review shop drawings, equipment submittals, TAB procedures and report formats for conformance with the OPR & Construction Documents.
- E. Update the Commissioning Plan to reflect equipment and controls submittal.

- F. Integrate the commissioning schedule into the Contractor's schedule.
- G. Provide System Verification Checklists (SVCs) for the pre-startup report.
- H. Develop and provide start-up reports and include any manufacturer's start-up requirements for the contractor's equipment start-up.
- I. Provide on-site inspections of the general installation as it progresses.
- J. Review or witness duct and hydronic leak testing.
- K. Review completed SVCs completed by the Contractor and sign off to release for start-up when completed.
- L. Witness controls operations, including point-to-point check out of all components.
- M. Review or witness TAB testing and report. During the commissioning efforts, the CxA shall expect to receive no more than 8 hours of onsite assistance from the TAB agency. This 8 hours is in addition to the time required to perform all TAB efforts as described in section 23 05 93.
- N. Merge all TAB deficiencies into report format for tracking.
- O. Incorporate all changes and Design Professional's responses to Contractor's requests for information.
- P. Notify Owner in writing when the systems are ready for the acceptance phase.
- Q. At a minimum, the following systems shall be commissioned:
 - 1. Heating, ventilating, air conditioning and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls.
- R. Based on operational system availability, conduct and document as early as possible (i.e., prior to any recommendation for Substantial Completion) functional testing of 100% of all major system components including point-by-point controls verification.

3.2 ACCEPTANCE PHASE ACTIVITIES—DURING THIS COMMISSIONING PHASE, THE CXA SHALL:

- A. Verify (in writing) the report test data of the Balancer's previously tested equipment.
- B. Check controls for proper calibrations, and list all controls requiring adjustment by control installers. A software functional performance point-by-point check-out and test, along with verification forms, shall be included in the Commissioning Report.
- C. Conduct Functional Tests and include the results in the Commissioning Report. If design/operating deviations beyond published allowable tolerances are identified, Owner reserves the right to require additional system testing. Owner will establish the scope in writing and approve proposed costs for additional services prior to commencement of any such additional testing. Functional Test shall include the following:
 - 1. HVAC Controls: Test and document control temperature or pressure readout of the device and compare to actual measured condition.

2. Sequence of Operations: Include all major systems such as AHU's, Chillers, DX equipment, and so on; and subsystems such as VAV's, Fans, Fan Coil Unit's, and so on; to verify proper operation. All interlocks shall be field verified. Include a description of operation in the Commissioning Report.
- D. **Visit site to review progress on a regular basis.** Note the progress and all deficiencies in a field report submitted to the Owner each visit. Deficiencies must be uniquely numbered and tracked, with the responsible party clearly identified. A consolidated deficiency list is to be included with the Commissioning Report. Indicate the status of each deficiency as either "Not Resolved" or "Resolved." All parties involved in the contract, including Engineer, CM (or GC), mechanical contractor, controls contractor, Test and Balance Agency, etc., shall sign each field report.
- E. Communicate with the installer that upon correction of the deficiencies, the installer shall notify the CxA in writing that the problem is resolved. If the deficiency is not corrected, the Contractor and Balancer will be responsible for the cost of additional re-testing.
- F. Verify and confirm in writing that HVAC systems (air, water, electrical, and capacities) have been adjusted and balanced within tolerances published in the Construction Documents.
- G. Organize and direct the Contractor/Vendor training of O&M personnel.
- H. Verify all required documentation has been furnished to Owner, including any information presented during training sessions.
- I. Review the operation of all commissioned systems with O&M staff and building occupants no more than ten (10) months following the date of Substantial Completion. Develop and submit to Owner a written plan for resolving any outstanding commissioning-related issues.

3.3 CxA SUBMITTALS

- A. Preliminary Commissioning Report: A preliminary report shall be issued to the Owner and shall identify:
 1. Itemization of deficiencies.
 2. Deferred test due to climatic conditions.
 3. Climatic conditions required for deferred test.

Final mechanical inspection shall not occur until code official has received a letter from the building owner acknowledging that the Building Owner has received the preliminary Commissioning Report.
- B. Final Commissioning Report: A Final Report shall be issued to the Owner and shall include the following.
 1. Results of functional tests.
 2. Resolution of deficiencies.
 3. Functional performance test procedures.

- C. Manuals: An operation and maintenance manual shall be provided that includes the following:
 - 1. Equipment submittal data.
 - 2. Manufacturer's operation and maintenance manuals.
 - 3. Name and address of at least one service agency capable of providing maintenance services.
 - 4. HVAC controls system maintenance and calibration information.
 - 5. A narrative of how each system is intended to be operated, including setpoints.
- D. After the CxA's receipt of equipment submittal data from the installer, equipment start-up forms will be transmitted from the CxA to the installer for use in equipment start-up. The completed forms will be returned to the CxA prior to the beginning of the test and commissioning phase.
- E. The final commissioning report shall be submitted within 90 days of the date of Certificate of Occupancy. The report shall document the function of all systems at the time of Substantial Completion of the project. All outstanding deficiencies shall be documented in the report. When all commissioning activities are complete, a final commissioning report will be submitted including all documentation and testing results.

3.4 CXA MEETINGS, OBSERVATIONS, AND TESTING

- A. Inspections: Conduct observations regularly during construction. Test systems for proper installation of balancing devices, for generally accepted construction practices related to each system.
- B. Verify installed work conforms with the Construction Documents.
- C. Perform Commissioning activities associated with the HVAC System as described herein.

3.5 CxA REPORTS

- A. Provide two (2) copies of tabulated report and one electronic copy in .pdf format, in neatly organized typed form. Report will include start-up reports and drawings to coincide with the commissioning report. In addition, all reports shall incorporate a summary page(s) which shall include:
 - 1. General description of project (building type, system type, equipment description, etc.)
 - 2. HVAC Equipment approved submittals (shop drawings).
 - 3. Functional Performance Test Reports
 - 4. Start-up reports.
 - 5. Observation reports with consolidated deficiency list.
 - 6. Point by Point control verification.

7. Systems' balance verification.
8. The final Test and Balance report with the engineer's letter of acceptance.

*** END OF SECTION 23 08 00 ***

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SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The General and Supplementary Conditions and General Requirements apply to the work specified in this section—Automatic Temperature Control System (ATCS).

1.2 SCOPE

- A. Provide materials, equipment, labor and supervision necessary to install a Controls building management and digital electronic automatic control system. Pneumatic controls are not acceptable.
- B. The system is based on any of the following acceptable manufacturers: Automated Building Controls (KMC), Honeywell, Johnson Controls, or Trane Tracer. Refer to the equipment schedules, flow diagrams, sequence of operation and input/output summary list as applicable to this project. The Mechanical Contractor is responsible for all coordination and scheduling of the control subcontractor.
- C. The system shall integrate with the County's current Trane Tracer ES front end and not require the use of any version of Java to operate.
- D. The system shall consist of a distributed processor direct digital control system utilizing electronic actuation. The system shall be fully integrated with the air handling units, VAV boxes, chillers, pumps, cooling towers and boilers. Every DDC control panel shall be listed by underwriters laboratory under "UL Standard 916 Energy Management Equipment".
- E. All electric control and interlock wiring in connection with the controls and instrumentation system shall be furnished by this Contractor. Power wiring to the various control devices shall be provided by the Electrical Contractor, coordinated by this Contractor prior to Bid. Failure of this Contractor to coordinate requirements with other Divisions shall require this Contractor to be responsible for any non-coordinated items. Control power to operate VAV boxes (other than duct heaters or fan power) shall be the responsibility of this Contractor (if applicable). The Electrical Contractor (Division 26) is to provide dedicated 120 VAC power or higher to each control panel.
- F. Include the cost of providing a system interface or graphics board (if required) and the required software to Engineering Matrix so that remote web based connection may be made between the project and the Engineer's office during the course of construction and throughout the warranty period. The intent is to allow the Engineer priority access during system installation, startup and demonstration. The Engineer shall also be able to use the system remotely in order to check/confirm the results of the test and balance reports in a random basis. Sufficient software shall be provided and installed at the office of the Engineer to allow full programming capability; to include: graphics programming language, module libraries, etc.
- G. Control Contractor shall complete all installations including electric and electronic components—not the Mechanical Contractor.
- H. DDC controllers shall be required to have been BTL (BACNET Testing Laboratory) tested and approved.

1.3 COORDINATION

- A. Division 15 Mechanical Contractor shall receive, handle, mount and install automatic temperature control valves, separable wells for immersion elements and couplings for flow and pressure switches.
- B. Mechanical Contractor for section 15 or the sheet metal subcontractor shall install all automatic dampers. It shall be the responsibility of the mechanical Contractor or his sheet metal subcontractor to provide and install blank-off plates when the control application requires dampers smaller than duct size.
- C. The direct digital portions and automatic temperature control system shall be installed by the Temperature Control Contractor.
- D. Coordination of all controls items with other trades shall be the responsibility of the Controls Contractor.

1.4 TEST

- A. The Control Contractor shall test the entire system and document point by point operation of all controls. Perform all required continuity testing of conductors prior to final connection to control equipment.

1.5 CALIBRATION AND ADJUSTMENT

- A. After completion of the installation, perform calibration and adjustments of the Automatic Temperature Control equipment provided under this contract, and supply services incidental to the proper performance of the temperature control system under the warranty below.

1.6 SYSTEM WARRANTY

- A. System Warranty

All temperature control devices provided by this Contractor shall be warranted to be free of defects in workmanship and material for a period of two (2) years from the date of the job acceptance (Final Substantial Completion) by the Owner and/or date of beneficial use. Any equipment found to be defective during this period shall be repaired or replaced without expense to the Owner. This work shall be accomplished by the Contractor during normal working hours (8 am to 5 pm, Monday through Friday, excluding holidays).

The Controls Contractor shall be responsible for all defects or failures throughout the warranty period (parts and labor).

- B. Service Organization Qualifications:

The Servicing Contractor shall meet all of the following requirements:

- 1. Have certified OEM factory-trained technicians experienced on the specific equipment needing repair. Service technicians to be equipped with laptop computers.
- 2. Provide for two (2) hour response time, 24 hours/day, 7 days/week to inspect down equipment and then repair to make equipment operational.

3. Maintain a complete stock of OEM parts, service, and repair manuals covering types and models of equipment owned by the Owner. It is unacceptable to remove a failed device and return it to the manufacturer for repair. Parts shall be replaced by local stock at the time of service call.
4. Have fully equipped service trucks and other equipment, including that necessary to comply with prudent and regulatory environmental requirements (including CFCs).
5. Maintain software library to support building automation system. Provide and install mandatory upgrades with 30 days of issue. All systems provided shall be the most current version and all units shall be the same version.
6. Provide local training on chillers, air handlers, and automation systems at no cost to Owner as stipulated herein.

1.7 SUBMITTAL REQUIREMENT

A. The following data/information shall be submitted for approval:

1. Complete description of operation. Include an overall system interconnect diagram showing all remote panels and power/surge protection locations.
2. Control system drawings including all pertinent data to provide a functional operating system.
3. Valve, humidifier and damper schedules showing size, configuration, capacity and location of all equipment.
4. Data sheets for all hardware and software control components.
5. A description of the installation materials including conduit, wire, flex, etc.
6. Thermostat/sensor locations.
7. Distributed panel locations.
8. Provide as part of the submittal five copies of all data.
9. Detailed point-to-point diagram of circuitry of all DDC panels, AHUs. Submit on a per distributed panel basis.
10. List of connected data points, including connected control unit and input or output device.
11. System graphics indicating monitored systems, data connected and calculated point addresses, and operator notations, as-built. Graphics shall be demonstrated at the office of the Engineer using live data via modem hook-up to the site. Graphics are to be demonstrated and approved prior to Substantial Completion. Not required at submittal approval time except as listed below.
12. Descriptive data and sequence of operation of operating, user, and application software.

13. Detailed documentation on the specific field equipment to be supplied by the controls Contractor shall be submitted and approved prior to installation; including, but not limited to, actuators, valves, temperature sensors, and damper operators.
14. All schemes and methods proposed to provide lightning protection entering and leaving each building shall be submitted for review and approval.
15. Locations of each control panel, gateway module, override panels on a 24" x 36" drawing or larger floor plan. Submit panel layouts for each.
16. Proposed Graphic Screens shall be submitted for approval with shop drawings. These submittals shall include a schematic of the graphics, all points which will be shown on that screen, whether such points are able to be overridden from the graphics and any such targets or macros to be accessible from that screen.

PART 2 PRODUCTS

2.1 DDC PANELS (MICROPROCESSOR BASED DDC PANELS)

Provide independent, stand alone, microprocessor based control panels in order to provide centralized control of each major piece of HVAC equipment. Provide DDC panels for each air handling unit. These panels shall communicate with the operator via the Communications Network CPU/Graphics Software. Both text and graphics interface shall be provided.

- A. The DDC panel shall contain the necessary hardware and firmware to interface the building input/output devices to the CPU over a communications channel.

Each DDC panel shall be a stand alone in a standard assembly packaged in a NEMA 1 enclosure complete with power supplies, card cage, interface cards and termination points. Each remote shall be capable of accepting combinations of input sensors and output controls. Each remote AHU unit shall have its' own timeclock.

As many DDC panels as required shall be furnished to provide the monitoring and control functions and capabilities specified. The panel shall be strategically located in areas of the building that are easily accessible for maintenance and repair.

Any software edit changes in a DDC panel by the Owner shall be available to the Owner. The Owner shall not be tied to the manufacturer for those changes.

If the manufacturer's panel does not have the ability to provide the minimum point requirement, then additional panels shall be provided adjacent to the first unit in order to meet the intent of the spec. No exception to this statement shall be acceptable in order to protect the Owner's interest for future additions.

Provide at each AHU, chillers and boiler (if applicable) a dedicated DDC panel. A key lock shall protect the internal DDC panel components.

Provide sufficient ROM, for operating system and PID algorithms. Protect processor cards and memory with internal grounding. Store setpoints and default parameters in a non-volatile memory (EEPROM). Battery back-up shall not be acceptable for AHU stand-alone DDC panel control. Locate the panel in the AHU room or at the AHU.

B. Input/Output Interface

Each point on each interface card is to be characterized as to its point type, sensor range, status, and scale range in the on-line software data base edit. Revisions or modifications to these parameters shall be entered by the system operator through the PC keyboard.

To gather sensor data and interface with controlled equipment, the DDC panel shall use an internal multiplex design. This design shall allow each panel to accommodate different types of points using any of the following input/output options:

- ☐ Digital Input Options—Monitor the open/closed status of a switch or relay.
- ☐ Analog Input Options—Monitor analog values of voltage, current and resistance from temperature, pressure and humidity sensors, etc.
- ☐ Digital Output Options—Control on/off, start/stop relays.
- ☐ Analog Output Options—Supply voltage or current outputs to controllers.

C. Digital Input (DI)

The digital inputs must be isolated contact closures and can either be normally open (NO) or normally closed (NC).

Points must be transient protected on all points to meet IEEE C37.90a-1974.

Digital input points shall monitor the open/close status of switches or relays. Digital inputs must be isolated contact closures, but normally open or normally closed contacts can be intermixed.

Monitoring voltage is 12 VDC at 12 mA per zone. Two #18 AWG wires are required per point. Points are to be transient protected to meet IEEE 472-1974.

D. Analog Input

The analog inputs can be voltage, current or resistance.

The analog input cards monitor values from temperature, pressure, humidity, and other analog sensors.

Analog inputs can be linear or non-linear. Points shall include a 10-bit A/D converter and an analog power supply. All points shall be wired to the card using #18 AWG twisted, shielded pair cables (Belden 8760 or equivalent) or larger.

E. Digital Output

The digital outputs shall drive control on/off, start/stop relays which have low voltage coils. The control relays must have a minimum contract rating of 120 VAC, 5 amp, and 1/3 HP. Provide manual override switches in order to enable the operator to override the control status of each load.

F. Analog Output

The analog outputs supply voltage or current outputs to devices. The analog outputs shall be a standard 4-20 mA proportional signal. The analog output D/A conversion shall have 10-bit resolution minimum. All output points to valves shall read as a percent open.

G. Packaging And Environment

Distributed DDC panel enclosures shall be locking type, metal cabinet, with common keying. The panels have a metal print pocket suitable for storing wiring, service and log information.

The panel, when required, must functionally operate over the temperature range -30 degrees F to 120 degrees F and the humidity range 10 - 90% non-condensing. Storage temperature shall be -50 degrees F to 150 degrees F.

DDC panels shall come with a minimum of six pre-existing available knockouts for ease of wiring during installation. Panels shall have an on/off switch and shall be fused for power protection. AHU DDC panels shall be provided with the required knock-outs.

The electrical requirements shall be provided by this Contractor. Any 120 VAC requirements are to be coordinated with the Division 16 Contractor prior to bid. Power circuit to each panel shall be provided by Division 16 Contractor.

H. Distributed Control Modules (DCMs)

The Distributed Control Module (referred to as DCMs) shall be distributed standalone controller specifically designed to control the various HVAC equipment as specified herein.

Each DCM shall be capable of communicating with main DDC controller panels over a twisted pair of wires. Provide at each panel an operator interface in the form of a front panel liquid crystal display with keypad. The display and keypad shall allow display and local adjustment of DCMs operating parameters and setpoints.

Each DCM shall have a minimum of 6 programmable/configurable PID loops.

The analog inputs shall be individually selectable for resistance inputs, 4 to 20 mA, 200 ohm input impedance and 0 to 10 VDC.

The binary outputs shall drive dry contact low coil voltage relays with normally open and normally closed (Form C) contacts. The contacts shall be rated at 120 VAC, 5 amps.

The analog outputs shall provide a continuous signal and are individually selectable as either 0-10 VDC or a 0-20 mA or 4-20 mA (both into a 500 ohm impedance).

Provide at each DCM address dip switches for setting the communication link address. In addition, provide at each DCM an RS 232 interface port for connection of a DCM edit software for use with a portable laptop computer.

Damper operators shall be of two (2) types; modulating or two-position depending on the sequence of operation. Two-position operators shall be spring return type and the modulating operators shall be capable of accepting a 0-10 VDC or 4-20 mA signal with a gear de-engagement clutch on the operator cover.

I. Main Direct Digital Controller (MDDC)

The Main Direct Digital Controller shall provide the capability for local loop control. The capability for direct digital control to maintain desired setpoints shall be available. The setpoint values shall be determined manually by the operator's input or by an application program. These values shall be established via the operator input locally or be set via the communications link to another MDDC. The MDDC shall be capable of retrieving data and setting data values from connected DCMs.

The MDDC panel shall have in firmware direct digital control PID loop algorithms for calculations to maintain a setpoint accurately. The algorithm shall utilize this desired setpoint value, mode factors, and feedback to maintain the setpoint. The factors for the mode used in the direct digital control process shall include proportional, integral and derivative value. Each MDDC shall have a minimum of 16 PID loops.

See the point list (I/O summary) for the required number and type of points at each piece of equipment.

2.2 TRANSIENT PROTECTION

- A. All communication channels between CPU, MDDC panels, and DCMs whether in conduits or overhead runs, shall have transient suppression networks installed. The transient protection must meet IEEE standard C37.90a-1974. The suppression network shall be automatic, self-restoring and be on duty at all times.
- B. Surge suppression shall comply at minimum with manufacturers requirements and is to include suppression on all lines entering/leaving each building.

2.3 SOFTWARE

Provide the following software features for the operation of the system:

A. Password Security

The system security software shall provide the means for ensuring secure operation of the system. In doing so, the system security software shall perform the following:

- 1. All system editing, control operations, and alarm acknowledgment shall be subject to access authorization prior to allowing such operations to take place.
- 2. Defining and modifying system password and access assignments shall only be accomplished by the Building Owner, Engineer, or Designee.
- 3. Associated with each password shall be an access code and level of authorization.

B. Application Software

The application software includes in general the control functions which permit the operator to control the system, and access the associated application parameters. In addition, the interaction between application programs provides the strategy for orderly management of the system as well as the following:

- 1. Maximum energy conservation
- 2. Minimum occupant discomfort

3. Unnecessary equipment cycling

All application program editing must be accessible to the Owner and the Owner's personnel who have the proper password authority. All displays necessary to create and edit the system are provided. All editing is done in English by using the menu format and by answering prompted questions. All software programming of sequences shall be done in text and shall be on-line with no intermediate compilations required.

C. Programmed Scheduling

The system shall provide the ability to automatically start up and shut down individual pieces of equipment by zone grouping based on a particular time of day. In addition, the ability to disable alarming and application control for a particular load as a function of the time-of-day is also required. All time programmed control will be done in accordance with the operator specified schedules.

There shall be a minimum of 32 master zone schedules of eight days each.

There shall be at least one schedule for each day of the week. The capability to schedule holidays and special days a minimum of one year in advance shall be included. The priorities of the time program functions relative to the other application programs shall be operator definable. The program shall have the capability of being down-loaded to all programmable remotes.

D. Demand Limiting And Load Shedding

Peak demand control shall be accomplished by monitoring the power consumption of each metered power feed device. The program shall constantly compare the actual peak demand to the operator established limits. Upon reaching limits, configurable priority loads as defined by user shall be shed on a rolling basis.

The program shall use an averaging technique that will offset the effects of demand spikes and the resultant over-shedding of loads.

The operator shall have the ability to define each load to be used for load shedding. In addition, the demand limiting program shall have as a minimum four priority groups. Each load in a particular group shall be rotated with other loads in the same group.

The program shall accommodate time of day demand limits.

There shall be a minimum of 2 time of day intervals with independent, unique limits for weekdays, Saturdays, and Sundays.

The program shall accommodate multiple meters as inputs to the software. It shall be capable of treating each independently. Associated system software shall be capable of treating them as a single sum.

E. Run Time And Maintenance

The system shall provide the ability to accumulate equipment run time for operator specified equipment.

When equipment run time exceeds an operator-specified limit, the system shall alarm the condition and print and sequentially number the maintenance order automatically for the specific piece of equipment. The system shall provide a summary of all points currently assigned to the run time program as well as their current run time values. Run time limits shall be enforceable on either an hourly or calendar date basis.

The operator shall have the ability to define or modify any of the maintenance messages to be used by the run time program.

F. Reports And Logs

The system shall provide management reports and logs detailing certain system performance characteristics.

The system shall have the ability to history trend a minimum of 250 different I/O or internally calculated points. The points shall be operator selectable and shall be a mix/match of the system points as selected by the operator. The operator shall also be able to select the sampling/storage trending time frequency. The minimum sample time frequency must be no greater than 10 minute intervals for 25 of the points and 5 minutes for the remaining points. A minimum of 200 samples for each point shall be trended.

The data or the trend history must be capable of being stored in a spreadsheet compatible file format (EXCEL Version 5.0).

G. Electronic VAV Control Software

The system shall provide a software program to control the VAV boxes which shall have the following minimum features:

1. The VAV terminal units shall be individually controlled by a DDC VAV controller which shall be furnished by the ATCS Contractor.

The cost to ship and mount, calibrate and test the DDC equipment shall be coordinated prior to bid day and included in the ATCS price.

Sensor installation to terminal unit and communications wiring to ATCS to be provided under this section. Coordination with the terminal unit provider shall be done by this Contractor prior to bid.

2. The ATCS shall perform the following VAV terminal unit control strategies and provide the points as listed on the DDC/VAV point list and the specified monitoring and diagnostics.

- a. AHU Grouping—The ATCS shall be able to group VAV boxes for each AHU via keyboard commands. These groups shall make it possible for the operator to send a common command to all boxes in a group to operate in the same mode. Also, each box can individually be commanded as well. ATCS shall also compile on a group basis, the following:

- ◆ Minimum group temperature
- ◆ Maximum group temperature
- ◆ Average group temperature

- b. Setpoint Control—The ATCS shall control the zone to space temperature setpoint of each VAV box. The zone temperature setpoint shall be operator adjustable. Individual zone setpoint and control logic shall reside at the zone level, and not be dependent upon the ATCS for control. In the event of communication loss, the box will continue to control the VAV damper valve to maintain current setpoints.
 - c. Cooling/Heating Valve Control—The ATCS shall control the cooling/heating air valve to a fully open, fully closed, maximum CFM, or minimum CFM position based on operator commands. The operator shall also have the capability to adjust the maximum and minimum airflow limits of the air valve through the ATCS, as well as command each valve to a current position. Heating and cooling shall each have their own unique maximum and minimum CFM adjustable setpoints.
 - d. Operating Mode—The ATCS shall place the box in either the occupied or unoccupied mode based on an operator adjustable time schedule. Separate heating and cooling setpoints shall be enterable for each mode through the ATCS. Other modes available for special applications shall include full open, full closed, maximum flow, and minimum flow.
 - e. Control Offset—The ATCS shall be capable of offsetting the cooling or heating setpoints of one or more groups of boxes by an operator adjustable amount. This capability will allow for automatic zone setpoint changes based on system requirements, such as demand limiting.
 - f. Automatic Recalibration—The system shall automatically recalibrate its air flow sensing and air valve position measurement system at system startup, on a scheduled basis, or on demand.
 - g. Terminal Unit Status Report—For each terminal unit, the ATCS shall provide an operating status summary of all unit sensed values (zone temperature, CFM, etc.), setpoints, and modes.
 - h. Terminal Unit Group Report—For each AHU group of VAV terminal units, the ATCS shall report the group mode, heating or cooling, airflow, average zone temperature, minimum zone temperature, and maximum zone temperature. The report shall also display for each terminal unit in the group the present temperature control setpoints and the current zone temperature.
3. Terminal Box Diagnostics
- a. If zone temperature sensor input fails above its high range, unit shall control at its maximum CFM setpoint. If sensor input fails below its low range, unit shall control to its minimum CFM setpoint.
 - b. If flow measuring system fails, unit shall automatically convert to a pressure dependent, damper position-based algorithm. Diagnostic message shall be displayed upon operator inquiry.
 - c. If communications are lost, controller shall continue to operate in the current mode of operation. All setpoints shall be retained in nonvolatile memory. If communications are not restored within 15 minutes, unit shall automatically initiate a reset-recalibrate.

4. Cooling Mode VAV Terminal Sequence:
 - a. On a rise in space temperature, the unit shall modulate up toward its maximum CFM.
 - b. On a drop in space temperature, the unit shall modulate toward its minimum CFM.
5. Heating Mode VAV Terminal Sequence:
 - a. On a rise in space temperature, the unit shall modulate down toward its minimum CFM.
 - b. On a drop in space temperature, the unit shall modulate toward its maximum CFM.
6. The control system shall include the capability of operating all of the VAV boxes and VAV air handlers in "Critical Zone Reset" mode. Supply air temperature of the AHU shall be reset via average AHU group space temperature.

H. Graphics Generation Package

1. Provide an updated version of the dynamic color graphics package to operate in the PC. The graphics package shall work in conjunction with the ATCS as described in Paragraph 2.01 A, B, C. The graphics package shall allow the operator to call up dynamic graphics and to create graphics in the following different methods.

- ☐ Drawing graphics from scratch with dimensions not exceeding 636 x 360 pixels.
- ☐ Redrawing an existing graphic (duplication).
- ☐ Using a library file from the graphics library. The graphics library shall contain as a minimum static pictures of AHUs, fans, chillers, valves, coils, dampers, fan coil units, and ductwork.

The graphics package shall be setup in SVGA mode with 256 colors and the ability to create/select fonts, text entry dialogue boxes, icons, etc.

2. Dynamic Graphic Software

Provide as part of this program an adjustable automatic refresh rate for all graphic displays. The automatic refresh rate shall be adjustable down to a minimum of five (5) seconds for all system points being displayed. A graphic mode's pop-up menu shall be provided for accessible selection of all available functions in a tiered top/down structure.

3. Color Graphic Display Linkage Editor

Provide, as part of the graphics generation program, a color graphic display linkage editor which assigns ("links") the appropriate graphic display files to the correct ATCS remotes. The linkage editor shall also provide the operator with the ability to define the display sequence that is followed when the next and previous function keys are utilized.

4. Graphic Requirements

As a part of the requirements of this section, provide a series of logically ordered dynamic graphics as described in paragraph H.1 for each ATCS remote. There shall be as a minimum a dynamic graphic for each of the following:

a. Site Plan Graphic

Provide a site plan of the project indicating location of chiller plant, major mechanical equipment, PCs, and electric power meter(s). The site plan graphics shall also have easily identifiable ICONS and target points.

b. Chiller Plant Graphics Group

The chiller plant graphics group shall consist of dynamic graphics of:

1) Chiller Plant Overlay

- ☒ All chillers
- ☒ System chilled water temperature(s) Deg.F. (supply and return)
- ☒ Chiller status (each chiller) on/off

2) Air Cooled Reciprocal, Helical Rotary or Scroll Chiller

- ☒ Chilled water supply temperature Deg.F.
- ☒ Chilled water return temperature Deg.F.
- ☒ Compressor (one required per compressor On/Off (status)
- ☒ Chilled water return (or supply) setpoint Deg. F.

c. Air Side

1) Air Handling Units - Constant Volume

- ☒ Fan start/stop control
- ☒ Fan status (On/Off)
- ☒ Return air temperature Deg.F.
- ☒ Supply air temperature Deg.F.
- ☒ Space temperature Deg.F.
- ☒ Space temperature setpoint Deg.F.
- ☒ Chilled water valve % open
- ☒ Cooling coil discharge temperature Deg.F.

2) Air Handling Units – Variable Volume

- ☒ Fan status (On/Off)
- ☒ Static Pressure (In.WG)

- ☒ Supply air temperature Deg.F.
- ☒ VFD position % frequency
- ☒ Chilled water valve % open
- ☒ Return air temperature Deg.F.
- ☒ Supply air temperature setpoint Deg.F.
- ☒ Static pressure setpoint Deg.F.
- ☒ Cooling coil discharge temperature Deg.F.
- ☒ Outside air CFM
- ☒ Outside air damper % open
- ☒ Return air damper % open

3) VAV Boxes

- ☐ Space temperature Deg.F.
- ☐ CFM max setting (heating/cooling)
- ☐ CFM min setting (heating/cooling)
- ☐ Cooling setpoint Deg.F. (occ/unocc)
- ☐ Heating setpoint Deg.F. (occ/unocc)
- ☐ Air valve % open
- ☐ Delivered CFM
- ☐ Fan status (on/off)
- ☐ Electric heating coils (on/off)

2.4 AUXILIARY CONTROL DEVICES

A. Automatic Control Dampers and Operators

1. Automatic control dampers shall have interlocking blades and frames. Dampers shall be designed and constructed so that the blades, frames and linkage mechanism shall present a rigid assembly with free and easy action. Dampers shall be of galvanized steel blades and welded steel frame. The damper bearings shall be brass or oil impregnated nylon with brass bearing shafts. Where the damper blades are installed in a vertical position, a thrust type ball bearing shall be provided for the lower bearing. All bearings in ducts or casings to the outside shall have the top and bottom edges on both ends trimmed with replaceable neoprene seal fastened in an approved manner, so as to be practically air tight when closed. Closed dampers shall have leakage of not more than one-half percent at 4" of water column (10.2 cm) static pressure and 2,000' per minute velocity.

2. Submit leakage and flow characteristics of dampers to Engineer to specify performance. Test leakage reports shall be in accordance with AMCA standard 500-75.
3. When dampers are located at fan discharge they shall be designed to operate properly without fluttering, at velocities up to 4,000 fpm and against a static pressure differential developed by the fan. Maximum deflection shall be no more than 1/50 of the unsupported span distance. Each automatic damper or section of damper if too large for one motor shall be operated by the required number of modulating motors. The motors shall be of the proper size required to operate the damper with uniform and gradual movement and shall return the damper to the same position for a given signal during an opening or closing movement of the damper. Damper operators shall be of the proportional type capable of accepting 0-10 volts or 4-20 mA control signal and 2-10 VDC feedback signal. The type of operator input signal will be a function of the DDC control panel output.
4. Damper operators shall include spring return, a 0 – 5 VDC feedback signal, and shall be sized a minimum of 125 percent of the highest actual close-off operating pressure of the system (25% safety factor). Contractor shall provide feedback wiring, terminations, graphics, and control logic connected to DDC input board (analog signal), on all outside air dampers on 100% outdoor air handling units wherever it applies to this project, for positive feedback of damper position.
5. Approved damper manufacturers are: Safe-Air and Ruskin.
6. The Control Contractor shall furnish all the controlled dampers of the type and sizes indicated on the Drawings for installation by the sheet metal subcontractor.
7. All 2-position control dampers shall be sized for minimum pressure drop, at the specified duct size.
8. All modulating dampers shall be sized for an effective linear air flow control characteristics within the angle of rotation and maximum pressure drops specified. Information shall be provided to the sheet metal subcontractor for determining the proper duct reductions or baffles used.
9. Damper frames shall not be less than 13 gauge galvanized steel, formed for extra strength, with mounting holes for enclosed duct mounting.
10. All damper blades shall be of not less than 16 gauge galvanized steel formed for strength and high velocity performance. Blades on all dampers must not be over 8" in width. Blades shall be secured 1/2" diameter zinc plated axles by zinc plated bolts and nuts. Blade side edges shall be sealed off against spring stainless steel seals. Teflon coated thrust bearings shall be provided at each end of every blade to minimize torque requirements and insure smooth operation. All blade linkage hardware shall be constructed of corrosion resistant, zinc plated steel and brass.
11. Dampers shall be suitable for operation between -40 F and 200 F. The Control Manufacturer shall submit leakage and flow characteristics plus a size schedule for all controlled dampers.
12. Dampers shall be of the parallel blade design for 2- position service and opposed blade design for modulating service.
13. Approved damper operator manufacturers are: Belimo.

B. Automatic Control Valves And Operators

1. The Control Contractor shall furnish all the control valves of the type indicated on the drawings for installation by the Mechanical Contractor.
2. All modulating straight-through water valves shall be provided with equal-percentage contoured throttling plugs. All modulating three-way mixing valves shall be provided with linear V-port plugs or equal percentage flow characterized ball valve type, such that the total flow through the valve shall remain constant regardless of the valve's position. All diverting valves shall have two V-port plugs.
3. Valves 2" and smaller shall have brass or bronze bodies with screwed ends. Valves 2-1/2" and larger shall have iron bodies brass or bronze trimming with flanged ends. Valves shall be factory rated to withstand the pressures encountered. Valves shall have stainless steel stems and spring loaded teflon packing.
4. Air handling unit water valves shall be sized for a pressure drop equal to the coil they serve but not to exceed 5 psi. Valves shall have replaceable seats and discs or equal percentage flow characterized ball valve type. Valves and operators shall be capable of close-off pressures equal to or exceeding the dead head pressure of the largest pump within the system or 60 psi, whichever is greater and shall be sized a minimum of 125 percent of the highest actual operating pressure of the system (25% safety factor).
5. All automatic control valves shall be fully modulating type unless specified otherwise in the Sequence of Operations or on the drawings.
6. All control valves shall be designed to fail as follows:
 - ☒ Cooling - Fail fully open to coil
 - ☒ Heating - Fail fully closed to coil
7. Each valve operator shall be 4-20 mA type Contractor shall provide feedback wiring, terminations, graphics, and control logic connected to DDC input board (analog signal), on all automatic control valves in the chiller plant and/or heating plant (except at air handlers) wherever it applies to this project, for positive feedback of valve position.
8. Operators on all air handlers shall be by Belimo and shall comply with this section.
9. Operators on all automatic control valves in the chiller plant and/or heating plant shall be Belimo SY, NEMA 4X type and shall comply with this section.
10. All Chilled water control valves shall be Ball valve type. No exceptions.

C. Differential Pressure Switches

1. Differential pressure switches shall be furnished as indicated by the sequence for status purposes for either air or water applications. Provide single pole double throw switch with fully adjustable differential pressure settings. The switch shall have a snap-acting Form C contact rated for the application. The switch contact shall be rated for 5 amps at 120 volts as a minimum. Units shall be selected for ranges consistent with the application and shall be submitted for the Engineer's approval.
 - a. Dwyer and Cleveland products are acceptable manufacturers.

D. Electronic Temperature Sensors

1. Temperature detectors shall be 10K Ohms thermistors or a 2 wire, 4-20 mA DC output 12-35 VDC input, 1,000 or 100 Ohm platinum RTD with a minimum transmitter accuracy of $\pm 0.1\%$ of span, shall be 100% zero and span field adjustable, polarity protected. Sensors shall be calibrated to less than or equal to a $1/4$ degree F resolution for the specific application. Thermistor sensors are approved for VAV zone or room sensing. Substitutions must be approved by the Engineer. All sensors to be field calibration verified and if adjustments are necessary, they shall be made at the sensor and not in software. 1,000 or 100 ohm direct panel input sensors are acceptable provided 2 fixed range resistors are installed that will facilitate confirmation of proper A/D conversion.
2. Provide twisted pair lead wires and shield for input circuit.
3. Use insertion elements in ducts not affected by temperature stratification or smaller than one square meter. Use averaging elements where larger or prone to stratification sensor length 2.5 m or 5 m as required.
4. Insertion elements for liquids shall be with brass separable socket (thermowell) with minimum insertion length of 2-1/2 inches (60 mm).
5. Supply room sensors with tamper proof cover.
6. Provide outside air sensors with watertight inlet fitting, shielded from direct rays of sun, mounted on the North side of the facility.
7. The transmitter/sensor shall be field calibrated by the Installing Contractor to transmit a 4-20 mA signal at the corresponding temperature ranges. The Installing Contractor shall calibrate transmitter in field with a precision grade substitution resistance box and two (2) decimal place minimum digital ammeter test circuit. Test transmitter at three (3) temperature points minimum. Engineer will spot check verify these calibrations during walk through inspection.
8. Wall mounted sensor shall be mounted at 5'-6" above finished floor in an area which free air current is not constricted or blocked, final location shall be approved by the Owner and Engineer prior to installation.
9. Elements shall be applicable for the medium being sensed; i.e., strap-on elements, room elements, well- mounted elements, duct mounted elements and outdoor mounted elements. Range shall be from 0 to 120 degrees F.

E. Electronic Static Pressure Sensors

Static pressure sensors shall be differential pressure sensors, with the "high" output sensing the duct pressure and the "low" input sensing the atmospheric pressure.

The range for the static pressure sensor shall be matched to the static pressure of the system being sensed, 0 to 0.5 inches, 0 to 2 inches, 0 to 5 inches, or 0 to 10 inches.

Accuracy shall be plus or minus 2% of the full range being sensed.

BAPI sensor with digital read-out display.

F. Thermostats

1. Provide Digital Stainless Steel Plate style sensor with NO user interface for Thermostats located in all areas unless noted otherwise on the drawings.
2. Two position (On/Off) room thermostat with bimetallic sensing element, setpoint thumbwheel dial, room temperature indicator, surface mounting base, and hard plastic coverplate, UL listed as manufactured by Barber Coleman, Series TC, or equivalent by Honeywell or Robertshaw. Provide this style of thermostat for equipment noted on the drawings to be controlled independent of the DDC Control System.

G. Humidity Sensor/Transmitter

Provide relative humidity sensor/transmitter where shown on the control drawings. Sensor and transmitter shall have:

System Accuracy+2% RH @ 25°C from 20-95% RH

Output Signal Two wire 4-20 mA linear, proportional to 0-100% RH

The transmitter power shall be compatible with and powered by, the low voltage power supplied by this Contractor.

H. Outside Air Monitor and Control

1. Each VAV air handling unit shall have an airflow control station capable of performing constant volume control of outside air without loss of required outside air at part load.
2. Each airflow monitor and control station shall be complete with velocity pressure transmitter and air volume flow rate control.
 - a. Pressure transmitter ranges shall be selected such that the velocities across the air monitor sensing element are at mid-range of the manufacturer's velocity range for the sensor.
 - b. The Controls Contractor shall verify any outside air dampers not used to achieve the velocity requirements are disconnected and permanently secured shut.
 - c. The Controls Contractor shall notify the Division 15 Contractor of any outside air openings that result in bypassing the air monitor sensor.
3. The major control instruments shall be capable of the following minimum performance:
 - a. Differential Pressure Transducer: The differential pressure transducer shall be capable of transmitting a linear 4 to 20 ma (or 0 to 10 volts) output signal proportional to the differential (velocity) pressure input signals within the following performance and applications criteria.
 - (1) Calibrated Spans not greater than 1-1/2 times the maximum design velocity pressure.
 - (2) Calibrated Overall Accuracy±1.0% of span.
 - (3) Repeatability±0.05% of output.

- (4) Operating Range of Sensor 20°F to 150°F.
 - (5) Operating Range of Transmitter ...20°F to 150°F.
 - (6) The transmitter output shall be unaffected by direction (or attitude) of mounting or external vibrations, and shall be furnished with a factory calibrated span.
 - 4. Units to comply with minimum manufacturer's up and downstream configuration, to be coordinated with Division 15 Contractor.
 - 5. All velocity to CFM calculations shall be done in the DDC system.
 - 6. Where called for on the AHU specifications, the AHU manufacturer shall provide the sensing station and matched velocity to signal conversion. Linearization and conversion from velocity to CFM shall be done in the DDC system.
 - 7. When using a duct mounted air monitoring station, the sensing station shall be the responsibility of the Controls Contractor. The velocity signal shall be brought into the DDC system. Linearization and conversion to CFM shall be accomplished in the DDC system.
- I. Airflow Measuring Stations (Duct Airflow Measuring Device)
- 1. Each device shall be designed and built to comply with, and provide results in accordance with accepted practice as defined for system testing in the latest revision of ASHRAE Handbook of Fundamentals as well as the latest revision of the Industrial Ventilation Handbook.
 - 2. Airflow measuring stations shall be fabricated of heavy galvanized steel welded casing with 90 degree connecting flanges in a configuration and size equal to that of the duct it is mounted into. Each station shall be complete with an air directionalizer and parallel cell profile suppresser across the entering air stream and mechanically fastened to the casing, equal-area and equal-weighted averaging total pressure sensors and manifold, bullet-nose shaped static pressure sensors with averaging manifold, internal piping, and external pressure transmitter ports. An identification label shall be placed on each unit casing listing model number, size, area, and specified airflow capacity.
 - 3. The maximum allowable pressure loss through the unit shall not exceed 0.1"w.g. Each unit shall be capable of measuring the airflow rate within an accuracy of 2% as determined by U.S. GSA. Certification tests shall contain a minimum of one total pressure sensor per thirty-six square inches of unit measuring area.
 - 4. Stations shall be installed in strict accordance with the manufacturer's published requirements. Final location shall be coordinated with the mechanical or the sheet metal subcontractor. These stations serve as the primary signals for the airflow control systems; therefore, it shall be the responsibility of the Contractor to verify location and installation to assure that accurate primary signals are obtained.
 - 5. The units shall have a self-generated sound rating of less than NC40, and the sound level within the duct shall not be amplified nor shall additional sound be generated.
 - 6. Stand-alone airflow measuring stations shall be Model HTA, as manufactured by EBTRON or pre-approved substitute. Refer to schedules and floor plans.

7. Each air monitor shall be tested by the Project TAB Contractor. Tests shall be conducted at full and part load fan capacity.

J. Control Wiring

1. All conductors shall be of stranded copper wire.
2. All EMT/conduit and outlet boxes shall conform to the requirements specified under Division 16, Electrical.
3. All cables run exposed in return air plenums shall be smoke rated for the application. Do not run wire in drywall without conduit.
4. All wiring cables shall have 600 volt insulation.
5. Cables shall be properly identified/tagged as to the control point.
6. All cables from ceilings to wall temperature sensors shall be installed in conduit (EMT).

K. Differential Pressure Transmitter/Orifice Flow Station

1. Transmitter: Provide a Rosemount Model 1151DP Alphaline Flange-mounted Differential Pressure Transmitter with all necessary installation hardware (seals, flanges, etc.). Unit shall be mounted at eye level for ease of calibration. Contractor shall calibrate instrument for 4-20 mA output (input into building control system). Coordinate the transmitter range with the requirements of the mechanical system prior to submitting shop drawings. The mounting flange shall be 150 psi rating class, 316 stainless steel. Sensor module and low side materials shall be 316 stainless steel. The high pressure side process fill shall be capable of air operating range of 0-200°F. Provide unit with LCD display, 0-100%. This Contractor shall provide power as required. Make all final piping connections to transmitter.
2. Orifice Plate: Furnish and install as shown on plans, a cast iron wafer-type flow meter designed for low pressure drop operation. The flow meter will be equipped with brass readout valves (with integral check valve) for taking differential pressure readings across the orifice of the flow meter. The flow meter shall be designed to operate at a maximum working pressure of 300 psig at 250°F. The flow meter must be furnished with a calibrated nameplate for determining an accurate system flowrate. Each flow meter shall be ITT Bell & Gossett Circuit Sensor Flow Meter Model No. OP-4A or approved equal.

L. Water Flow Meter

1. Furnish an in-line, bidirectional, electromagnetic flow meter. Paddle type flow meters and insertion type flow meters shall not be acceptable. Each meter shall be individually calibrated and tagged accordingly against the manufacturer's primary standards which must be traceable to the U.S. National Institute of Standards and Technology (NIST).
2. The meter shall have a maximum operating pressure of 230 PSI, maximum operating temperature of 220 degrees F. Accuracy shall be +/- 0.003% from 0.033 fps to 1.6 fps and +/-0.2% from 1.6 fps to 33 fps within actual reading.

3. The sensor shall have integral 4-20 mA current output for connection to the ATCS system. The sensor shall also include (2) isolated programmable digital/pulse outputs configurable for frequency, pulse, alarm, or directional flow.
4. The outer body shall be painted carbon steel. The flow tube shall be 304 stainless steel.
5. The meter shall have backlit 16 character display, 8 line graphic LCD display for flow rate, velocity, flow direction, totals, short term trend data and error messages.
5. Basis of design
 - a. Onicon Model F-3200

M. Hydronic Energy Meters, Chilled Water

1. Provide an Onicon System 10 BTU Meter at each location where chilled water enters the buildings, prior to any branches or secondary take offs. Refer to drawings for locations.
2. Furnish Onicon System-10 BTU Meters with differential temperature accuracy of +/- 0.15°F, liquid temperature range of 32° to 200°F and an alphanumeric LCD to display total energy, total flow, energy rate, flow rate, supply temperature and return temperature.
3. The BTU meter shall provide complete energy, flow and temperature data to the Control System through a single BACnet network connection.
4. Provide water flow meter as specified in Section "Water Flow Meter."

N. Make-up Water Meter

1. Furnish an approved single turbine flow sensor complete with hot tap full port ball valve and installation hardware. Paddle type rotors will not be acceptable. Rotational sensing of the turbine shall be accomplished electronically by sensing impedance change and not with magnetic or photoelectric means. Each sensor shall be individually calibrated and tagged accordingly against the manufacturers primary standards, which must be accurate to within 0.1% traceable to the U.S. National Institute of Standards and Technology (NIST).
2. The sensor shall have a maximum operating pressure of 227 PSI, maximum operating temperature of 250 degrees F, (optional 300 degrees F) and a pressure drop of less than 1 PSI at 17 feet per second flow rate. Flow sensor shall have 32: 1 turndown ratio. Accuracy shall be +/- 1% of actual reading from 0.4 feet per second to 20.0 feet per second.
3. The sensor shall have integral analog outputs of 0 to 24 vdc and/or 4-20 m A current output for connection to the DDC system. The sensor shall also include an internal frequency output consisting of 0 to 15 VDC pulses for diagnostics purposes and for connection to peripheral equipment (local display, BTU meter, etc.). All outputs shall be linear with flow.

4. The turbine element shall have EDPM o-ring seals. be made of polypropylene (optional polysulfone) with sapphire jewel bearings and tungsten carbide shafts. The flow sensor shall be constructed of Brass for sizes $\frac{3}{4}$ "- $1\frac{1}{2}$ " and Epoxy coated cast iron for sizes 2"-10" with aluminum electronics enclosure and gasket cover.
5. Basis of design is Niagara Model 860 (MTX or WPX depending on size) with digital pulse transmitter module.

O. Current Switches

1. Provide a solid state switch which when the current level sensed by the internal current transformer exceeds the adjustable trip point. Internal circuits are to be totally powered by induction from the line being monitored. Provide a zero off-state leakage in the solid-state relay output, while switching both AC and DC circuits. Provide an LED that will show three pieces of information (Rapid Flashing-switch is tripped, Slow Flashing-current is present but below the trip point and no Flashing-current is either off or below the bottom of the range) and permits setting the trip point adjustment prior to system connection.

P. Filter Status Transmitter

1. Provide filter status for all central station air handling units. The transmitter shall have both visual monitoring and electronic control of very low differential pressure. The transmitter shall have 4-20ma output signal to be used by the DDC system. Fan coil units shall not have filter status unless the Engineer recommends it.
2. Transmitter shall be Dwyer series 605.

Q. Variable Frequency Drive (VFD) Motor Speed Controller (Refer to Drawings for Voltage, Size, and Location found on Pump and/or Air Handling Unit Equipment Schedules)

1. Variable Frequency Drives and other Adjustable Speed Drives/Controllers are to be provided by others and interfaced by this Controls Contractor into the DDC system;
2. Provide the following minimum hard-wired discrete inputs/outputs between the drives and the DDC system:
 - a. AO to control drive speed;
 - b. AI reference to monitor actual drive speed;
 - c. BO to activate the drive;
 - d. BI for drive failure alarm (drive fault).
3. If specifically called for on the plans, provide a communications integration interface between the drive and DDC system. This requirement shall not replace the requirement for the listed minimum discrete I/O points.

R. Outside Air Monitor and Control

1. Each VAV air handling unit shall have an airflow control station capable of performing constant volume control of outside air without loss of required outside air at part load.

2. Each airflow monitor and control station shall be complete with velocity pressure transmitter and air volume flow rate control.
 - a. Pressure transmitter ranges shall be selected such that the velocities across the air monitor sensing element are at mid-range of the manufacturer's velocity range for the sensor.
 - b. The Controls Contractor shall verify any outside air dampers not used to achieve the velocity requirements are disconnected and permanently secured shut.
 - c. The Controls Contractor shall notify the Division 15 Contractor of any outside air openings that result in bypassing the air monitor sensor.
3. The major control instruments shall be capable of the following minimum performance:
 - a. Differential Pressure Transducer: The differential pressure transducer shall be capable of transmitting a linear 4 to 20 ma (or 0 to 10 volts) output signal proportional to the differential (velocity) pressure input signals within the following performance and applications criteria.
 - (1) Calibrated Spans not greater than 1-1/2 times the maximum design velocity pressure.
 - (2) Calibrated Overall Accuracy $\pm 1.0\%$ of span.
 - (3) Repeatability $\pm 0.05\%$ of output.
 - (4) Operating Range of Sensor 20°F to 150°F.
 - (5) Operating Range of Transmitter ...20°F to 150°F.
 - (6) The transmitter output shall be unaffected by direction (or attitude) of mounting or external vibrations, and shall be furnished with a factory calibrated span and be field verifiable.
4. Units shall comply with the minimum manufacturer's upstream and downstream configuration, to be coordinated with Division 15 Contractor.
5. All velocity to CFM calculations shall be done in the DDC system.
6. Where called for on the AHU specifications, the AHU manufacturer shall provide the sensing station and matched velocity to signal conversion. Linearization and conversion from velocity to CFM shall be done in the DDC system.
7. When using a duct mounted air monitoring station, the sensing station shall be the responsibility of the Controls Contractor. The velocity signal shall be brought into the DDC system. Linearization and conversion to CFM shall be accomplished in the DDC system.

S. Airflow Measuring Stations (Duct Airflow Measuring Device)

1. Each device shall be designed and built to comply with, and provide results in accordance with accepted practice as defined for system testing in the latest revision of ASHRAE Handbook of Fundamentals as well as the latest revision of the Industrial Ventilation Handbook.
2. Airflow measuring stations shall be fabricated of heavy galvanized steel welded casing with 90 degree connecting flanges in a configuration and size equal to that of the duct it is mounted into. Each station shall be complete with an air directionalizer and parallel cell profile suppresser across the entering air stream and mechanically fastened to the casing, equal-area and equal-weighted averaging total pressure sensors and manifold, bullet-nose shaped static pressure sensors with averaging manifold, internal piping, and external pressure transmitter ports. An identification label shall be placed on each unit casing listing model number, size, area, and specified airflow capacity.
3. The maximum allowable pressure loss through the unit shall not exceed 0.1"w.g. Each unit shall be capable of measuring the airflow rate within an accuracy of 2% as determined by U.S. GSA. Certification tests shall contain a minimum of one total pressure sensor per thirty-six square inches of unit measuring area.
4. Stations shall be installed in strict accordance with the manufacturer's published requirements. Final location shall be coordinated with the mechanical or the sheet metal subcontractor. These stations serve as the primary signals for the airflow control systems; therefore, it shall be the responsibility of the Contractor to verify location and installation to assure that accurate primary signals are obtained.
5. The units shall have a self-generated sound rating of less than NC40, and the sound level within the duct shall not be amplified nor shall additional sound be generated.
6. Stand-alone airflow measuring stations shall be Model HTA, as manufactured by EBTRON or pre-approved substitute. Refer to schedules and floor plans.
7. Each air monitor shall be tested by the Project TAB Contractor. Tests shall be conducted at full and part load fan capacity.

2.5 AHU OUTSIDE AIR-RETURN AIR, AIR-FOIL CONTROL DAMPER WITH SALT WATER "SW" RESISTANCE OPTION

- A. Extruded aluminum (6063-T5) damper frame shall not be less than 0.080" in thickness. Damper frame shall be 4" deep x 1", with duct mounting flanges on both sides of frame. Damper frame shall have a 2" mounting flange on the rear of the damper when installed as Extended Rear Flange install type. Aluminum frame shall be clear anodized to a minimum thickness of 0.7 mil deep. Frame shall be assembled using stainless steel screws.
- B. Blades shall be maximum 6.4" deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 0.06", clear anodized to a minimum thickness of 0.7 mil deep. All blades shall be symmetrically pivoted.
- C. Blade seals shall be extruded silicone, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals will not be approved.

- D. Frame seals shall be extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.
- E. Bearings shall be a dual bearing system composed of a Celcon inner bearing (fixed around a 7/16" aluminum hexagon blade pivot pin), rotating within a polycarbonate outer bearing inserted in the frame. Single axle bearing, rotating in an extruded or punched hole shall not be acceptable.
- F. Hexagonal control shaft shall be 7/16". It shall have an adjustable length and shall be an integral part of the blade axle. All parts shall be stainless steel.
- G. Linkage hardware shall be aluminum and stainless steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with stainless steel cup-point trunnion screws to prevent linkage slippage and a Celcon bearing between moving parts to reduce wear and increase longevity.
- H. Dampers shall be designed for operation in temperatures ranging from -40°F to 212°F.
- I. Dampers shall be AMCA rated for Leakage Class 1A at 1 in. w.g. static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.
- J. Dampers shall be custom made to required size, with blade stops not exceeding 1¼" in height. The blade stop shall be a continuous and integral part of the head/sill. Welded and caulked blade stops shall not be acceptable.
- K. Dampers shall be opposed blade, or as indicated on the plans.
- L. Dampers shall be installed in the following manner: Installed in Duct, or as noted on drawings.
- M. Installation of dampers must be in accordance with manufacturers current installation guidelines, provided with each damper shipment.
- N. Field-supplied intermediate structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width.
- O. Aluminum end caps shall be press fitted to blade ends, in order to seal hollow interior and reduce air leakage rates
- P. Acceptable product shall be TAMCO Series 1500 Air-Foil Control Damper, as manufactured by T. A. Morrison & Co., Inc. or approved equal
- Q. Dampers shall be installed in ductwork runouts to AHU OA and RA duct connections and be located as close to AHU as possible.

PART 3 INSTALLATION

3.1 CONTROL WIRING

- A. Provide conduit and outlet boxes.
- B. Install remote push-button stations and/or control devices interposed in the control wiring.

- C. Provide over-current protection for all control and interlock wiring as specified in NFPA (70.1971) Art. 240-5 (a), Exception #4 and Art. 430-72, Exception.
- D. Line voltage and exposed low voltage control wiring shall be run in conduit.
- E. No splices will be allowed except at junction boxes and control centers.
- F. No two wires of the same color shall be run in one conduit unless wires of the same color are properly tagged at both ends and any splice points. Do not change colors at splice points.

3.2 INSTALLATION

- A. The control sequences indicated in the specifications herein show the intended sequences of operation of the various control systems and shall be followed completely, deviations are not acceptable.
- B. Each control system shall be complete with all necessary thermostats, valves, relays, switches, accessories, etc., and all interconnections, and so arranged that they will provide the proper automatic sequence of operation between the various control devices as required to maintain the desired temperature, conditions and sequences.
- C. All control equipment shall be fully modulating unless otherwise noted, and relays or accessories not specifically mentioned but required for proper operation shall be included.
- D. The system shall be installed by competent mechanics and electricians regularly employed by the controls Contractor. Installation by mechanical Contractor is not acceptable.
- E. Control and instrument wiring and capillaries are to be secured to building structure—not to ductwork.
- F. The exact location of instruments, panelboards, accessories, etc., not definitely located shall be approved by the Architect/Engineer.
- G. All automatic controls and accessories shall be located in accessible locations.
- H. All non-panel, as well as panel mounted instruments, shall be clearly labeled as to use and system served by means of engraved laminated nameplates.
- I. Where control instruments or accessories are to be installed on covered casings, ductwork, etc., they shall be mounted on the finished surface of the covering. Care shall be taken that there are no leaks around the stems where they pass through the metal work.
- J. All modulating control valves, dampers, etc., shall operate in a slow, gradual manner without any jerking or slamming.
- K. All controls shall operate satisfactorily without any cycling or hunting. The manufacturer shall furnish any necessary additional controls, relays or damping devices as required to correct cycling or hunt that occurs in any part of the control system after the system is in operation.
- L. Automatic control manufacturer shall provide power to all electric actuators requiring external power source whether they are furnished by him or part of other equipment.

- M. Electronic VAV controllers, motors, and sensors shall be provided under this scope of work. The control Contractor shall also include the cost of mounting controllers and motors by the VAV box manufacturer in his price.
- N. The Automatic Control Contractor shall furnish all motorized valves and dampers to the Mechanical Contractor for installation.

3.3 CONTROL MANUFACTURER'S FIELD SERVICES AND INSTRUCTIONAL REQUIREMENTS

- A. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation. On-site training shall not begin until the system has been accepted by the Engineer and field verifications completed.
- B. Local Training (Classroom Training): Local training shall be provided for up to 7 of the Owner's representatives (6 staff members and the Engineer of Record). Local training may be held at the Owner's site or at the local distributors offices at the sole discretion of the Engineer. This training shall be customized to address only specific hardware/software used at the site. A working understanding of documentation formats shall be a part of this training. Course outline and schedule shall be submitted to the Engineer no less than 30 days prior to commencement. Training shall consist of both lecture and hands-on format and must address troubleshooting as well as operation of the system and in accordance with the training syllabus described herein.

The training syllabus shall include as a minimum the following:

☐ System Architecture and Overview

- ☒ Menus
- ☒ Demo disk/workshop
- ☒ Building control
- ☒ Scheduling
- ☒ Zone control
- ☒ Trend logs
- ☒ Program priorities

☐ Application Troubleshooting

- ☒ System set-up
- ☒ Times and dates
- ☒ Input/output data
- ☒ Configuration
- ☒ ICS local programming
- ☒ Building status/graphics

- ☒ Maintenance procedures
- ☒ Troubleshooting procedures

Schedule shall be for no less than four (4) hours of such instruction per individual. Local training shall be completed within 15 days prior to substantial completion, but after field verification. Cost of local training is a part of this contract.

- C. On-site Training: On-site training shall be provided for up to 7 of the Owner's representatives (6 staff members and the Engineer of Record). This training shall be completed in groups of no more than 4 persons per group at one time in one 4-hour session for each group. The training shall focus on the specific installation and shall address both hardware and software. This training shall be completed after local training and after substantial completion. Specific as-built documentation for this project shall be used for reference as a part of this training. Pre-submit course outline to Engineer as stated above.
- D. For all levels of training, a sign-off sheet shall be submitted to the Engineer certifying that each individual has completed such training to acceptance of individual. Hours of instruction received shall be a part of the sign-off sheet.
- E. It shall be the Owner's responsibility to provide adequate time for attendance at all training sessions.
- F. Training Aids: Provide an "Owner's Copy" factory prepared DVD describing in layman's terms the complete operation of the system. This DVD shall be professionally made by the manufacturer of the system. DVDs (home made) locally are not acceptable. Provide a copy of this DVD with the submittal package to the Engineer for approval prior to proceeding.

3.4 DEMONSTRATION

- A. General: Provide field testing and adjustment of the complete EMCS and on-site, operational acceptance test of the complete operational EMCS. The Owner may witness all tests.
- B. Field Test: When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on line. All testing, calibration, adjusting, and final field tests shall be completed by the Controls Manufacturer. Provide a cross check of each control point within the EMCS by making a comparison between the control demand at the Master and field controlled device. Verify that all systems are operable from local controls in the specified failure mode upon EMCS failure or loss of power. Verify that all systems return to EMCS control automatically upon resumption of EMCS operation or return of power. Submit the results of functional, cross and diagnostic tests.
- C. The Controls Manufacturer shall, as a part of the base scope, provide two (2) days of operational verification, on-site, with the design Engineer present throughout. The verification shall be completed during two (2) continuous days during building non-occupancy, at the end of the final phase of project construction. This two (2) day period shall be over a weekend unless otherwise agreed upon in writing by the Controls Manufacturer and Engineer at the end of the two (2) day period.

The punchlist items shall be corrected by the Installer to the satisfaction of the Engineer within a two (2) week period directly following the verification period and shall be demonstrated to the Engineer on a weekend day in order to complete the verification process. This process shall continue until all items have been successfully demonstrated and acknowledged to the Engineer in writing. This must be completed prior to substantial completion.

3.5 ACCEPTANCE AND WARRANTY

- A. An acceptance test of the completed system in the presence of the Owner's representative and the Engineer shall be performed. When the system performance is deemed satisfactory by these observers and all record (as-built) drawings have been received by the Owner, that part of the system shall be accepted for beneficial use and shall be considered complete.
- B. All control hardware, software, and firmware delivered to the Installer by the Controls Manufacturer shall be warranted by the Controls Manufacturer for a period of two (2) years following the date of completion. Defects arising during this warranty period shall be corrected without cost to the Owner.

3.6 CONTRACTOR TRENDING REQUIREMENTS

- A. Contractor shall configure the system to provide Excel Spreadsheets showing all points (I/O; virtual points; Setpoints; etc.) referenced in the documents at 5 minute intervals. Coordinate the number of spreadsheets and layout with the Engineer of Record. The spreadsheets shall be electronically submitted weekly to the Engineer throughout the Warranty period. The first such spreadsheet shall be submitted and approved for content and format by the Engineer prior to Substantial Completion. Weekly submittal shall be consistent in layout week to week.

PART 4 SEQUENCE OF OPERATION

4.1 GENERAL

- A. Refer to the Controls Drawings for written Sequence of Operation.
- B. The Control Contractor is responsible to provide/add the required points to correctly perform the specified sequence of operation.

*** END OF SECTION 23 09 00 ***

SECTION 23 11 00 - DUAL WALL CONTAINMENT PIPING

PART 1 GENERAL

1.1 WORK SECTION INCLUDES

- A. Provide and install all equipment, piping, fitting, and accessories for a complete dual containment diesel fuel piping system as specified herein.
- B. Types of fuel dispensing equipment required include, but are not limited to:
 - 1. Double wall containment piping and fittings. (Piping path from storage tank to day tank. Piping path from storage tank to fueling station.)

1.2 RELATED WORK

- A. Drawing and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Although such work is not specifically shown or specified all appurtenances and devices incidental to or necessary for a sound, secure, safe and complete installation shall be furnished and installed as a part of this work.
- C. Coordinate dual containment fuel piping connection requirements with Division 16.

1.3 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the current provisions of all codes Federal, State, County and City related to work being accomplished and following codes, specifications and standards except where more stringent requirements are shown or specified.
 - 1. Underwriters Laboratories (UL) codes.
 - 2. National Fire Protection Agency (NFPA) codes.
 - 3. National Electric (NEC) codes.
 - 4. Environmental Protection Agency (EPA) codes.
 - 5. Department of Environmental Regulation (DER) codes.
 - 6. OSHA codes and guidelines.
 - 7. Manufacturer's installation and operational guidelines.
- B. Current National Fire Protection Agency, "Standard for the Installation of Oil Burning Equipment", NFPA 31 (ANSI Z95.1) and the "Flammable and Combustible Liquids Code, NFPA 30, FDER 17-761
- C. Installer Qualifications: A Contractor with minimum of 6 years experience in performing installation and servicing of underground diesel fuel piping.

- D. Requirements of Regulatory Agency: All work shall conform to the applicable requirement of the Federal, State, County and City codes and NFPA 30. The monitoring system shall conform to the requirements of Florida Statute 376-303, Chapter 17-761, Stationary Tanks. All components shall be UL listed. If in any part of the plans and specifications conflict with the above codes, it shall be the responsibility of the Contractor to notify the Architect-Engineer before contract has been negotiated, it shall be the responsibility of the Contractor to conform with the above codes at no additional expense to the Owner and shall advise the Architect-Engineer before making and changes.
 - 1. The Contractor shall coordinate necessary testing with the Department of Environmental Regulations and submit to the Owner, Certificates indicating installation is in full compliance with DER regulations.
- E. The Contractor shall provide a licensed Pollutant Storage Systems Contractor and shall direct and be responsible for the installation of the fueling station.

1.4 SUBMITTALS

- A. General: All submittals shall follow guidelines as specified in Section 15010 Basic Mechanical Requirements and Section 16010 Basic Electrical Requirements.
- B. Product Data: Prior to placing any work, submit manufacturer's product data, specifications, installation and maintenance instructions and schematic piping and wiring diagrams for each type of equipment required to the Architect-Engineer. Submittals shall be in accordance with Section 15010 and Section 16010 and shall include:
 - 1. Piping
 - 2. Fittings
 - 3. Piping specialties
 - 4. All items listed herein.

Restrict submitted material to pertinent data. For instance do not include manufacturer's complete catalog when pertinent information is contained on a single page.

- C. Operation and Maintenance Manuals: Provide complete parts, operating, and maintenance manual covering equipment at time of installation including, but not limited to:
 - 1. Description of system and components.
 - 2. Schematic diagrams of electrical, hydraulic, pneumatic and mechanical systems.
 - 3. Manufacturer's printed operating instructions.
 - 4. Printed listing of periodic preventative maintenance items and recommended frequency required to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.
 - 5. List of original manufacturer's parts, including suppliers' part numbers and cuts, recommended spare parts stockage quantity and local parts and service source.

6. Assemble and provide copies of manual 8 1/2 by 11 inch format. Foldout diagrams and illustrations are acceptable. Manual to be reproducible by photo copy method. Provide copies per provisions of Division I - General Requirements.
- D. Shop Drawings: Provide and submit signed and sealed shop drawings and details for piping, venting, electrical wiring and equipment installation as required for this project. All sub contractors shall obtain written certificates from the Contractor and installer indicating that shop drawings comply with the regulations of all local, city, county, state and federal authorities who have jurisdiction over the proposed project.
- E. Certificates: Dated certificates of inspection and system approval by all local, city, county, state and federal governing authorities shall be delivered in triplicate to the Architect-Engineer prior to final acceptance of the work. The Contractor shall obtain written certification from all manufacturers that installer is approved by manufacturer for installation of specific system.
- F. The Contractor shall provide primary products including tools and accessories necessary to perform the special work and/or approved by a single manufacturer.
- G. The manufacturer determines the distributors or supplies of this product and directly or indirectly has responsibility for selecting the method of transport and of storage, therefore, the manufacturer must be considered fully responsible for materials until such are delivered into the hands and control of the Contractor.
- H. Templates: The Contractor shall provide and submit templates for anchor bolts, and other items set in concrete.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Division 1, General Requirements, and products/handling/delivery/storage shall conform to the minimum recommendations of the manufacturers of the products herein specified.

1.6 ERRORS AND OMISSIONS

- A. If, due to an error or omission in the scope of work, a particular item is not specifically included but is necessary to provide the Owner with a fully functional fueling facility, then that item is considered to be included in the scope of work just as if it had been listed in detail herein.

1.7 PRODUCT SUBSTITUTIONS

- A. Follow requirements specified in Division I - General Requirements.
- B. Additional costs resulting from substitution of products other than those specified, including drawing changes and construction, will be at the expense of the Contractor.
- C. Substitution Approval: Manufacturer's listed for each equipment item may bid without submittal for that item. Manufacturers not listed shall submit for approval in accordance with "Instructions to Bidders". Prior to installation, submittals for each equipment items by Mark Number shall be provided in accordance with Division I - General requirements.

PART 2 PRODUCTS

2.1 PIPING

- A. General: Contractor to furnish and install all labor and equipment, product piping, vent piping and fittings including connections and appurtenances to install equipment for a complete and code approved operating fuel station.
1. Drawings reflect general piping layout and shall be followed as a guide in the preparation of shop drawings.
 2. The Contractor is advised that the extent of piping shown on the drawings may not include all containment fittings and necessary items needed for a complete installation. It is the Contractor's responsibility to include all such items as well as piping diagram with the shop drawings.
 3. The Contractor shall submit shop drawings of the piping layout indicating joints, flexible connectors, pipe sizes and burial depth, and all installation detailing.
 4. The Contractor shall obtain written certification from manufacturer of piping that installer is approved by manufacturer for installation of specific system.
 5. Provide a written certificate indicating that shop drawings comply with the regulations of all authorities having jurisdiction over the proposed project and submit to the Architect/Engineer.
 6. The Contractor shall provide primary products including tools and accessories necessary to perform the special piping work and/or approved by a single manufacturer.
 7. The manufacturer determines the distributors or supplies of this product and directly or indirectly has responsibility for selecting the method of transport and of storage, therefore, the manufacturer must be considered fully responsible for materials until such are delivered into the hands and control of the Contractor.
- B. Contractor to furnish and install all above Ground Pipe and Fittings.
1. Steel pipe: Schedule 40, ASTM A120, galvanized.
 2. Fittings: 150 lb., galvanized malleable iron.
 3. Unions and Couplings: API 300 lbs., galvanized malleable iron.
 4. Joint Compound: Gas Oila or approved equal.
- C. Fiberglass Pipe and Fittings: Contractor to furnish and install all fiberglass pipe and fittings which shall be, UL listed, Dualoy 3000/L as manufactured by Ameron or approved equal. The complete fuel carrying pipe system shall be installed within the next larger size Dualoy 3000/L pipe to provide a Secondary Containment System.
1. Straight Pipe: Filament-wound fiberglass reinforced epoxy with integral epoxy liner and external coating suitable for use with petroleum products; both primary piping and secondary containment piping.
 2. Fittings: Compression molded and filament - wound fiberglass reinforced epoxy.

3. Primary Piping Fittings: Molded fiberglass reinforced epoxy one piece units.
4. Secondary Containment Fittings: Custom fabricated molded fiberglass reinforced epoxy, 2 piece split units, with threaded fasteners for dry-assembly of fitting during installation.
5. Joints: Matching tapered bell and spigot, adhesive joints.
6. Adhesive: Two-part amine cured epoxy
 - a. Primary Piping: as recommended by pipe manufacturer.
 - b. Secondary Containment Piping: as recommended by pipe manufacturer.
7. Taper Kits: as recommended by pipe manufacturer.
8. Insulation Wrap: as recommended by pipe manufacturer.
9. Bonding Kits: as recommended by pipe manufacturer.
10. Nominal Size: A 2" diameter primary pipe and a 3" diameter secondary pipe shall be used to form a secondary containment system.

2.2 FLEXIBLE CONNECTORS WITH SECONDARY CONTAINMENT JACKET

- A. Flexible Connectors: Contractor to furnish and install UL listed, convoluted "Teflon" innercore reinforced with "Teflon" impregnated fiberglass, braided stainless steel inner jacket, and braided nonmetallic outer jacket; NPT threaded fittings each end. Provide manufacturer's 20 year warranty. Connector shall be as manufacturer by Resisto-Flex or approved equal.
- B. Secondary Containment Jacket: Contractor to furnish and supply, UL listed, flexible jacket to provide secondary containment of flexible connector. Secondary containment jacket shall be as manufactured by Containment Technology or approved equal.

PART 3 EXECUTION

3.1 PREPARATION AND INSTALLATION OF PIPING

- A. Prior to installation of the piping, the Contractor shall carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence. Verify that the piping system can be installed in strict accordance with all appropriate codes and regulations, the manufacturer's recommendations as approved by the Architect-Engineer and the original design.
- B. The Contractor shall install all on a slope so that liquids flow toward the tanks. The following minimum slopes shall apply to all piping:
 1. Vapor recovery piping - 1/8" per foot.
 2. Product piping - 1/8" per foot.
 3. Vent piping - 1/4" per foot.

- C. Contractor shall follow current manufacturer's installation practices.
- D. Contractor shall lay pipe and fittings true to line with true 90 degree and 45 degree offsets to prevent abnormal stress on pipe and fittings.
- E. Contractor shall make all pipe connections neat, tight, and leakproof.
- F. Contractor shall use fiberglass pipe and fittings specified herein for all horizontal underground piping.
- G. Contractor shall use "Resisto-flex" flexible connectors between submersible pumps and product carrying fiberglass pipe. Provide secondary containment piping around flexible connectors using 45 degrees elbow fittings and straight pipe.
- H. Contractor shall use new galvanized steel pipe and fittings specified herein for risers and vertical vent piping.
 - 1. Wrap all underground galvanized steel pipe and fittings with one layer of 20 mil plastic tape or 2 layers of 10 mil plastic tape using primer specifically compounded for tape use. Spiral wrap each layer with 1/2" overlap.
- I. Test Equipment Hook-up: A crossover from the fiberglass pipe to steel is required at both ends of the line. Ordinarily, this will be the crossover fittings that is to be used for the permanent tie-in. The gauge should be between the valve and the line so that it indicates the line pressure after the valve is closed.
- J. Test Pressure: The recommended hydrostatic test pressure is one and a half times expected the operating pressure and should be maintained for at least 10 minutes. Do not exceed one and half times the rating of the system. Check pressure rating of all components of the system - not just the pipe - because tanks or hoses may be rated lower than the pipe.
- K. Monitoring: It is recommended that 5 to 10 psi pressure be maintained in the primary pipe during construction of the rest of the facility to monitor the integrity of the pipeline. This way damaged caused by stakes, tools, etc. can be detected and corrected before paving is installed or product is pumped through the pipe.
- L. Warning: Pneumatic testing is extremely dangerous and is not recommended. Hydrostatic testing is recommended.

*** END OF SECTION 23 11 00 ***

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and hydronic specialties for the following:
 - 1. Pre-insulated Underground pipe and fittings.
 - 2. Chilled-water piping.
 - 3. Makeup-water piping.
 - 4. Condensate-drain piping.
 - 5. Blowdown-drain piping.
 - 6. Air-vents and Air-vent piping.
 - 7. Safety-valve-inlet and -outlet piping.
 - 8. Air Separators
 - 9. Strainers.
 - 10. P/T Plugs.
 - 11. Calibrated Balancing Valves.
 - 12. Relief Valves.
 - 13. Suction Diffusers.
 - 14. Thermometers.
 - 15. Pressure Gauges.
- B. Related Sections include the following:
 - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
 - 2. Division 23 Section "Hydronic Piping Specialties" equipment and accessories for hydronic piping systems.

3. Division 23 Section "HVAC Water Treatment" flushing, cleaning and chemical water treatment for hydronic piping systems.

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. Chilled-Water Piping: 150 psig at 200 deg F (93 deg C).
 2. Chilled-Water Piping: 150 psig at 200 deg F (93 deg C).
 3. Makeup-Water Piping: 150 psig at 200 deg F (93 deg C).
 4. Condensate-Drain Piping: 150 psig at 200 deg F (93 deg C).
 5. Blowdown-Drain Piping: 200 deg F (93 deg C).
 6. Air-Vent Piping: 200 deg F (93 deg C).
 7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 SUBMITTALS

- A. Product Data: For each type of the following:
 1. Plastic pipe and fittings with solvent cement.
 2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 3. Air control devices.
 4. Flushing, cleaning and chemical treatment methodology, products, equipment and procedures including begin and end schedule.
 5. Hydronic specialties.
 6. Pipe, Fittings and Field Insulation Methodology
- B. Shop Drawings: Detail, at 1:20 scale (or as appropriate for representation of details), 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.

- C. Welding certificates.
- D. Qualification Data: For Installer.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.
- G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
- B. 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.
- C. 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.

1.7 EXTRA MATERIALS

- A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.
- B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 PRODUCTS

2.1 PRE-INSULATED UNDERGROUND PIPE AND FITTINGS

- A. General
 - 1. Factory fabricated, pre-insulated piping system shall be used underground for chilled water service, using a welded jointing method.
 - 2. Unless otherwise specified, all pipe, fittings, valves, and accessories shall conform to the requirements of ANSI B31.1, and shall be of the proper type for pressure and temperature of the water systems.
- B. Carrier pipe
 - 1. Carrier pipe shall be ASTM A-53 ERW, Grade B, butt weld, standard weight.

2. All pipe cut to length in the field and fittings shall be protected from water and dirt damage by installing rubber end seals or factory fabricated PVC caps over the casing and carrier pipe sealing the ends completely from exposure. In no case shall open ends of fittings or pipes be left exposed to the environment either in the field or en route.

C. HDPE Casing Pipe

1. Seamless High Density Polyethylene (HDPE) conforming to ASTM D1248. Piping wrap shall be heat shrunk at closures.
2. Minimum jacket thickness shall be in accordance with insulation thickness table.

D. Insulation

1. Insulation shall be Polyurethane foam and shall meet the following specifications:
 - a. Type: Two component urethane
 - b. Compressive Strength: 25 psi parallel min. at 5% comp.
 - c. Shrinkage: None at 70 F.
 - d. Free Rise Density: 2 to 3 lbs/cubic foot.
 - e. Aged "K" (70°F - 72 hrs): 0.14 @75 F BTU per inch per hour, per degree Fahrenheit, per square foot.
 - f. Closed Cell Content: 90-95% in conformance with ASTM 1784 completely filling the annular space between carrier pipe and jacketing.
 - g. Minimum thickness shall be per Insulation Thickness Table.

E. Casing Coupling

1. The casing coupling shall be HDPE meeting classification requirements of ASTM D1248. The coupling shall be SDR 51 or heavier in accordance with ASTM D2241. Insulate at each coupling with polyurethane foam to fill annular space between carrier pipe and casing.
2. Method of sealing the couplings shall be as follows:
 - a. Slip the casing coupling over the joined pipe sections. The casing coupling shall then be wrapped with heat shrink material in the field to provide a watertight seal (minimum thickness of exterior wrap shall be 60 mils).

F. Fittings

1. Fittings shall be pre-insulated by the piping system manufacturer using the same insulation thickness and casing as the pipe.
2. All fittings and expansion fittings shall be fabricated as detailed on drawings.

3. Field insulation of fittings utilizing factory approved insulation kits is also acceptable. PVC sleeve extenders and fitting covers shall be sealed with heat shrink tape after insulation of fitting is complete. Fitting cover shall be completely wrapped from one end to the other with heat shrink tape.

G. Penetration Sleeves

1. Provide where piping passes through masonry or concrete walls, floors, and roofs.
2. Sleeves in outside walls below and above grade, in floor, or in roof slabs, shall be schedule 40 or standard weight coated black steel pipe.
3. Space between piping or insulation casing, and the sleeve shall be sufficient to allow proper water tight sealing, but never less than 1/2".
4. Sleeves shall be held securely in proper position and location during construction.
5. Sleeves shall be of sufficient length to pass through entire thickness of walls or slabs. Sleeves in floor slabs shall extend 2 inch above the finished floor.
6. Refer to drawings for details.

H. Penetration Seals

1. All penetrations shall be sealed to prevent water from entering the building. (Refer to details on drawings.)

I. Insulation Thickness Table

1. Thickness of insulation for pre-fabricated insulated pipe and fittings shall be as follows:

NOMINAL PIPE SIZE IN INCHES	MINIMUM INSULATION THICKNESS IN INCHES	JACKET SIZE IN INCHES	JACKET THICKNESS IN MILS
1	1.91	5.4	125
1.5	1.62	5.4	125
2	1.38	5.4	125
2.5	1.77	6.7	125
3	1.46	6.7	125
4	1.96	8.7	125
6	1.98	10.85	125
8	1.95	12.85	150
10	1.52	14.12	150
12	1.53	16.14	150
14	1.88	18.22	150
16	1.92	20.3	175
18	1.90	22.3	175

J. Dimensions

1. The pre-fabricated insulated piping shall be furnished in 20' random lengths.

K. The pre-fabricated insulated piping system shall be as manufactured by Rovanco Corp., Thermal Pipe Systems, Inc., Ricwil, Thermacor Process, Energy Task Force, or Insultek.

L. Anchors: Anchors shall be 1/4" thick plate steel and extend 2-1/2" beyond the casing diameter. Anchors shall be pre-fabricated (attached to steel pipe) and sealed to pipe jacketing with pipe manufacturers standard anchor insulation kit. Location of anchors shall be a part of shop drawing submittal for approval by the Engineer. Anchor assembly shall be poured in concrete block by Contractor in field. Concrete blocks shall generally extend 12" in all directions from the anchor and rest on undisturbed earth.

M. Provide shop drawings of underground piping system, calculate, provide and show all expansion loops required for expansion and contraction of piping system. Shop drawings shall indicate depth of pipes required for system. Coordinate depth with all other trades and show on shop drawings all locations of underground utilities which may pose a conflict or require special care during installation. Expansion/contraction compensation will be accomplished utilizing factory pre-fabricated and pre-insulated expansion elbows, Z-bends, expansion loops, and anchors specifically designed for the intended application. External expansion compensation utilizing flexible expansion pads (minimum one inch thickness), extending on either side, both inside and outside the radius of the fittings are used with all fittings having expansion in excess of 1/2".

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company of America.

C. Wrought-Copper Unions: ASME B16.22.

2.3 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. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

- C. 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:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
 - 4. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- D. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 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. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. 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.
- E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:

1. 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:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:

1. 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:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Factory-fabricated companion-flange assembly, for 150 minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

1. 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:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150 psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings:

1. 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:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.

G. Dielectric Nipples:

1. 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:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Victaulic Company of America.
2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, and 300-psig minimum working pressure at 225 deg F.

2.6 VALVES

- A. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Tour & Andersson; available through Victaulic Company of America.
 - c. Macon
 - d. Mepco.
 2. CWP Rating: Minimum 125 psig.
 3. Maximum Operating Temperature: 250 deg F.
 4. Furnish and install, as shown on plans and with manufacturer's recommendations, Model CBV-T threaded type circuit balancing valves.

5. Each valve shall have metering ports incorporating Nordel check valves on both sides of the seat.
 6. All valves shall be "Y" pattern, equal percentage, globe style, designed either for presetting with a balance schedule or for proportional balancing. All metal parts are bronze copper alloy. Each valve shall provide four functions:
 - a. precise flow measurement;
 - b. precision flow balancing;
 - c. positive shutoff with a no-drip soft seat; and
 - d. diagnostic point for system analysis.
 7. A 1/4" NPT tapped drain port shall be provided on each side of valve seat.
 8. Valves shall have four (4) full 360 degree adjustment turns of the handwheel (1,440 degrees) with a micrometer-type indicator and hidden memory feature to program the valve for a precise, tamper-proof, balanced setting. When installed, the handwheel and metering ports shall not be located on the bottom of the valve to prevent sediment deposits. Handwheel scale must be able to be positioned so that it may be clearly read without the use of mirrors or any special tools. Metering ports shall be interchangeable with drain ports to allow for read-out flexibility when installed in tight piping locations.
 9. Each threaded CBV-T to be shipped with a pre-formed insulation to meet or exceed ASTM D1784/Class 14253-C, MEA #7-87, ASTM E84, and ASTM E136 with a flame spread rating of 25 or less and a smoke development rating of 50 or less.
- D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Tour & Andersson; available through Victaulic Company of America.
 - c. Macon
 - d. Mepco.
 2. CWP Rating: Minimum 125 psig.
 3. Maximum Operating Temperature: 250 deg F.
 4. CBV-G 2 1/2" through 12" Flanged:
 5. Furnish and install, as shown on plans and with manufacturer's recommendations, Circuit Balancing Valves.
 6. The valve body shall be ductile iron with grooved ends or with Armgrip(tm) non-rotating ductile iron flange adapters. Valves shall be suitable for the working pressures and temperatures as shown on drawings.

7. Each valve shall have metering ports incorporating Nordel check valves, on both sides of the seat.
 8. All valves shall be "Y" pattern, modified equal percentage, globe style, designed either for presetting with a balance schedule or for proportional balancing. Each valve shall perform four functions:
 - a. precise flow measurement
 - b. precision flow balancing
 - c. positive shutoff with a no-drip soft seat; and
 - d. diagnostic point for system analysis.
 9. Valves shall have five, (2½" and 3") six, (4" through 6") twelve, (8") ten, (10") or fourteen (12") full 360 degree adjustment turns of the handwheel with a micrometer-type indicator and hidden memory feature to program the valve for a precise, tamper-proof balanced setting. When installed, the handwheel and metering ports shall not be located on the bottom of the valve to prevent sediment deposits. Handwheel scale must be able to be positioned so that it may clearly read without the use of mirrors or any special tools.
 10. Circuit balancing valves shall be installed at least five pipe diameters downstream from any fitting and at least ten pipe diameters downstream from any pump. Two pipe diameters downstream of the CBV shall be free of any fitting.
 11. The valve shall be furnished with pre-formed insulation to meet or exceed ASTM D1784/Class 14253-C, MEA #7-87, ASTM E84, and ASTM E136 with a flame spread rating of 25 or less and a smoke development rating of 50 or less.
- E. Diaphragm-Operated, Pressure-Reducing Valves:
1. 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:
 - 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.
 4. Seat: Brass.

5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: S.S. screen, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
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. 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:
 - 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.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: S.S. screen, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
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.

2.7 AIR CONTROL DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amtrol, Inc.
 - 2. Armstrong Pumps, Inc.
 - 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - 4. Taco.
- B. Manual Air Vents:
 - 1. Body: Bronze.
 - 2. Internal Parts: Nonferrous.
 - 3. Operator: Screwdriver or thumbscrew.
 - 4. Inlet Connection: NPS 1/2.
 - 5. Discharge Connection: NPS 1/8.
 - 6. CWP Rating: 150 psig.
 - 7. Maximum Operating Temperature: 225 deg F.
- C. Automatic Air Vents:
 - 1. Body: Bronze or cast iron.
 - 2. Internal Parts: Nonferrous.
 - 3. Operator: Noncorrosive metal float.
 - 4. Inlet Connection: NPS 1/2.
 - 5. Discharge Connection: NPS 1/4.
 - 6. CWP Rating: 150 psig.
 - 7. Maximum Operating Temperature: 240 deg F.
- D. Diaphragm-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. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Tangential-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.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.

2.8 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: 125 psig.

B. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

C. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

2.9 THERMOMETERS

- A. Provide thermometers where indicated, specified, and required. They shall be installed so that they can be clearly read from the floor.

- B. Industrial stem thermometers shall have a scale not less than 9" long and shall be red-reading mercury type with white background and black etched graduations and numerals. Casing materials shall be aluminum on all products installed outdoors.
- C. Thermometers shall be suitable for the service intended and the range shall be selected to span from approximately 10 degrees below through 10 degrees above the operating range of the fluid.
- D. Thermometers shall have a guaranteed accuracy of within 1% of the range scale and shall be provided with 1 degree graduations. Thermometers shall be provided with brass separable socket wells.
- E. Provide thermometer wells and necessary fittings where specified or indicated. Wells installed in insulated piping shall be provided with lagging extensions of appropriate length to accommodate insulation.
- F. Thermometers shall be as manufactured by Marsh Instrument Co., Weksler Instrumentation, Trerice, Miljoco, or approved equal.

2.10 PRESSURE GAUGES

- A. Pressure and compound pressure gauges shall be installed so that they can be clearly read from the floor and shall be Bronze Bourdon tube type with minimum 6" dials and snubbers. Dials shall be white with black numerals, graduations, and pointers, and shall be set in either iron, steel, or aluminum cases having a baked enamel finish. Cases shall have safety blowout plugs.
- B. Pressure gauges shall have a range of approximately twice the operating pressure and all gauges shall have an accuracy of 1/2 of 1% of full scale reading. Gauges shall be provided with brass shutoff cocks.
- C. Provide compound pressure gauges in pump suction pipe (30" Hg VAC. to 100 psi).
- D. Provide gauges where indicated, specified, or required.
- E. Gauges shall be manufactured by Marshalltown Instrument, Weksler Instrumentation, Trerice, Miljoco, or approved equal.

2.11 P/T PLUGS

- A. Provide, in locations shown on drawings, a 1/2 inch MPT fitting for pipe line and 1/4 inch for valve body locations to receive either a temperature or pressure probe 1/8 inch OD. Fitting shall be solid brass with two valve cores of Neoprene capable of withstanding a maximum temperature of 200 deg. F at 500 psi, fitted with a color coded and marked cap with gasket, and shall be rated at 1000 psig at 140 deg. F.
- B. Provide Owner with pressure gauge adapters with 1/8" O.D. probe and 5 inch testing thermometers for chilled water with a 25 - 125 F range.
- C. Supply and present to the Owner upon completion of testing, two (2) pressure and temperature test kits. Each shall consist of one dual scale (0-100 psi, 0-230 feet of water) pressure gauge with a No. 500 gauge adapter attached, one 25-125 F pocket testing thermometer, one 0-220 F pocket testing thermometer, one 500 gauge adapter, and one protective carrying case.

- D. Acceptable manufacturers shall be Peterson, Sisco, or approved equal.

2.12 SUCTION DIFFUSER

- A. Provide a suction diffuser at inlet of each base mounted pump. Unit shall consist of angle type body with inlet vanes and combination Diffuser-Strainer-Orifice cylinder with 3/16" diameter openings for pump protection. Unit shall be equipped with disposable fine mesh start-up strainer which shall be removed after thirty (30) days of operation. Strainer free area shall be no less than five (5) times the section area of the pump connection. Unit shall be provided with adjustable support foot to carry weight of suction piping.
- B. Suction diffusers shall be as manufactured by Bell and Gossett, TACO, Armstrong, Titan FCI, or Mueller.

PART 3 EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping and chilled water piping, aboveground, NPS 2 and smaller shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered pressure-seal joints.
 2. Schedule 40 steel pipe; Class 150 or Class 300 Malleable Iron fittings; and threaded joints.
- B. Hot-water heating piping, and 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.
- C. Makeup-water piping installed aboveground shall be the following:
1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- D. Makeup-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
1. Condensate-Drain Piping: Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- E. Air-Vent Piping:
1. Inlet: Same materials and joining methods as for piping specified for the service in which air-vent is installed.
- F. 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.

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 where indicated on the drawings.
- C. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- D. 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.
- E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

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.
- 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 and 3/4 inch hose connection 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 valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- P. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- Q. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- R. 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. Provide strainer blowdown valve with 3/4 inch hose connection with cap.
- S. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
- T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

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 hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4 to NPS 1-1/4: Maximum span, 6.5 feet; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 3. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 6. NPS 4: Maximum span, 10 feet; minimum rod size, 5/8 inch.
 - 7. NPS 6: Maximum span, 10 feet; minimum rod size, 5/8 inch.
 - 8. NPS 8: Maximum span, 14 feet; minimum rod size, 7/8 inch.
 - 9. NPS 10: Maximum span, 14 feet; minimum rod size, 7/8 inch.
 - 10. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
 - 11. NPS 14: Maximum span, 20 feet; minimum rod size, 1 inch.
 - 12. NPS 16: Maximum span, 20 feet; minimum rod size, 1 inch.

13. NPS 18: Maximum span, 20 feet; minimum rod size, 1-1/4 inches.
14. NPS 20: Maximum span, 20 feet; minimum rod size, 1-1/4 inches.
- C. 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, 3/8 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 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.
- D. 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.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

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 piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger. Install automatic air vents at top of air separator. Refer to detail on drawings for further information..
- 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 bypass chemical feeders in each hydronic system where indicated, in upright position. Install feeder in minimum NPS 3/4 insulated bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
- F. Install expansion tanks on the minimum 4" pad housekeeping. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements. Refer to details.
- G. Flow switches, temperature sensors, sensor sockets, wells gage taps, etc. shall be furnished under controls section of these specifications and installed under this Section. Locations of all sensor sockets, flow switches, and taps shall be coordinated with and supervised by the Controls Contractor.
- H. Motorized control valves shall be furnished by the Controls Contractor, installed by the Mechanical Contractor.

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. Provide P/T ports at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping." Refer to details.
- E. Install thermowells and ports for pressure gages and thermometers at equipment as indicated on details and according to Division 23 Section "Meters and Gages for HVAC Piping." Refer to details.

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. Set makeup pressure-reducing valves for required system pressure.
 4. 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).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

3.9 UNDERGROUND PIPE INSTALLATION

A. General

1. Installation of exterior buried factory-prefabricated preinsulated chilled water piping systems shall be in accordance with manufacturer's installation manual. Welding of steel piping including qualification of welders shall be in accordance with ASME B31.1, metallic arc process. Install piping straight and true to bear evenly on sand bedding material.
2. Installation Drawings: The system supplier shall provide engineered drawings of the piping layout indicating anchor locations and provisions for expansion and/or contraction. Computerized stress calculations including anchor forces shall be provided by the system manufacturer upon receipt from the installing contractor approved drawings complete with field measured dimensions. Drawing shall be signed and sealed by a P.E. employed by the piping manufacturer.
3. All units shall be part-numbered and dimensionalized for proper installation of the system.
4. Insulate and jacket field joints as indicated on the drawings.
5. Pipe handling: Pipe and accessories shall be handled in a manner to ensure delivery to the trench in an undamaged condition. Particular care shall be taken not to injure the pipe jacket and insulation. If any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in an approved manner. The interior of pipe and accessories shall be cleaned before being lowered into the trench for welding connection operations.
6. Cleaning of Piping: Keep interior and ends of new piping and existing piping affected by the Contractor's operations, cleaned of water and foreign matter during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of pipe and fittings to prevent entry of water and foreign matter. Inspect piping before placing into position.
7. Demolition: Remove materials so as not to damage materials which are to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction.

B. Field Joints

1. Carrier Piping Joints Without Concrete Anchor: Pressure test and approve piping joints. Provide joints with polyurethane insulation of same type and thickness as insulation on carrier piping. Provide waterproof shrink sleeves to cover insulation and overlap not less than 6 inches of each end of conduit section. Seal joint jacket watertight to adjacent jacketing to withstand 20 feet of hydrostatic water pressure.
2. Carrier Piping Joints With Concrete Anchor: Pressure test and approve piping joints. Provide each tee with concrete anchors (thrust blocks). Provide waterproof end seals between carrier piping and conduit. Encase carrier pipe fitting and conduit with a minimum of 6 inches of concrete or as otherwise shown in details or per manufacturer's calculations.

- C. Assembly and Alignment: Assemble carrier pipe and fittings according to manufacturer's installation manual. Maintain proper alignment during assembly of welded joints and flanged joints.
- D. Bedding: Accurately grade trench bedding with a minimum of 6 inches of manufactured or natural sand. Backfill sand to a minimum of 4 inches below conduit. Lay bedding to firmly support conduit along entire length.
- E. Concrete: Thrust Blocks: Encase each tee of carrier pipe in thrust block against undisturbed soil. Disturbed soil under and around thrust blocks shall be compacted. Pour concrete anchor blocks where shown on installation drawings. After all anchor blocks are poured and cured, a hydrostatic test of shall be required as specified under Section 15990. No leakages shall be allowed.
- F. Field Quality Control
 - 1. Before final acceptance of work, test each system to demonstrate compliance with contract requirements. Thoroughly flush and clean piping before placing in operation. Flush piping at minimum velocity of 8 fps. Correct defects in the work and repeat tests until work is in compliance with contract requirements. Furnish potable water, electricity, instruments, connecting devices, and personnel for tests.
 - 2. The services of a factory trained field service instructor directly employed by the system manufacturer (factory certified sales agent or representative) shall be required during the installation (once at the beginning for instructing the Contractor, once at the midpoint, and once at the end point of the project) and on-site to witness each hydronic test. The Instructor must obtain a daily written report from the Installation Contractor identifying progress and potential conflicts. The written report shall be presented to the Instructor on the same day it is prepared, one copy shall be forwarded to manufacturer's office, and one copy shall be forwarded to the Engineer's office.

The Instructor shall prepare site inspection reports which shall state whether or not the condition and quality of materials used and the installation of the system are in accordance with the manufacturer's approved drawing and published literature and is satisfactory in all respects, each time the instructor visits the site. A final report shall be signed by an officer of the manufacturer and duly notarized certifying the materials are installed in accordance with the manufacturers requirements and recommendations and will satisfactorily serve the intended use, including maintaining an insulation barrier between the pipe and surrounding soil, for the anticipated service life of the pipe.
 - 3. Immediately after the system is installed in the ditch, a partial backfill shall be made in the middle of each unit leaving the joints exposed for inspection prior to the hydrostatic tests. The initial backfill is to be 12" of select materials, hand tamped in 6" layers above the jacket. Do not use frozen fill, sod, cinders or stones greater than 1/4" as backfill.
 - 4. Field Tests of Carrier Piping: Do not cover carrier piping joints with insulation or concrete anchors (thrust blocks), until carrier piping joints pass field tests.

5. Hydrostatic Pressure Test: Test piping system in accordance with the requirements herein. Refer to the Field Quality Control Section below. During hydrostatic pressure test, examine piping system for leaks. Repair leaking joints, replace damaged and porous pipe and fittings with new materials, and repeat tests. The piping shall be tested in sections as required by the Contracting Officer to coordinate with disruption of utilities and traffic patterns. Contractor shall provide the necessary flanges, blank-off plates and valves for sectionalized testing.
6. After hydrostatic testing, backfill all remaining exposed pipe as instructed. Final backfill of selected earth shall be hand-placed and tamped in 12" layers over the top of the initial backfill. Remainder of the backfill shall be free of large boulders, rocks over 6" in diameter, frozen earth, or foreign matter. The backfill operation shall now be completed by any convenient means. Do not use wheeled or tracked vehicles for tamping.
7. Thrust Blocks: Place bedding and backfill around center portion of piping system, leaving thrust blocks and field joints clear for observation. After successful completion of hydrostatic pressure test, cast concrete thrust blocks.
8. Field Inspections: Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.10 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. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.11 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 (125 psi) . 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. Set makeup pressure-reducing valves for required system pressure.
 4. 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).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

3.12 CLEANING SEQUENCE

- A. Hydronic Water Systems: Contractor shall rent a pump with strainer and pipe to new system. Contractor shall circulate for 48 hours, then drain systems as quickly as possible. Refill with clean water, circulate for 24 hours, then drain. Refill with clean water and repeat until system cleaner is removed. After cleaning and flushing, the Contractor shall connect new piping to existing system as shown on drawings. Chemical Water treatment to be provided immediately upon acceptance of the cleaning.

- B. The piping shall be thoroughly flushed with cleaned throughout with clean potable water at a rate of 6 to 8 feet per minute through the largest pipe on the circuit but not exceeding a pressure of 100 psi in the piping system. Provide a temporary bypass on the boiler piping to allow full circulation throughout the existing piping system including as much of the new piping system as possible minus the boilers and pumps. The temporary connection of the supply and return pipe at boiler bypass shall facilitate the flow of water through the piping system during flushing. Flush each heating branch and main system for a minimum of two hours and until the flushing water exiting the piping is clear and free of debris as determined by the owner's chemical treatment company. The source of the water supply to be used for flushing shall be as approved by the authority having jurisdiction. The contractor shall provide the temporary pumping system to be used for flushing the piping system. The new boiler pumps shall not be used as the flushing pumps. The flushing pumps shall be of the capacity (flow rate and dynamic head) as necessary to motivate the water through the largest pipe in the system at a minimum 6 fpm velocity. Provide temporary flexible piping and connections to the system as necessary to and from the flushing pumps.
- C. Provide all necessary utility connections to the flushing pumps including power, make-up water, drain piping, etc. as necessary for safe operation. If diesel driven flushing pumps are used, these pumps shall be located outdoors in the appropriate open air environment far enough away from the building intake openings such that the diesel exhaust fumes do not pose any threats or perceived threats to the safety of the building environment and building occupants.
- D. Prior the flushing and cleaning, this contractor shall remove, clean and reinstall all strainers on the heating system in the building. Upon completion of the flushing and cleaning process, this contractor shall again remove, clean and reinstall all strainers, and fill system with clean water. Adjust the expansion tank for pressure proper operation.
- E. Once the system has been flushed, add cleaner to closed systems at concentration as recommended by manufacturer of water contained in the system; of one pound per 100 gallons of water for hot systems and one pound per 50 gallons of water for cold systems.
- F. Each piping system shall be thoroughly cleaned by filling with a solution of commercial cleaning chemicals designed to remove deposits such as pipe dope, oils, loose mill scale, rust and other extraneous materials. The recommended dosages and characteristics of the cleaner shall be such that the water need only be at ambient temperature. After the recommended dosages are added, the water shall be circulated for 36-72 hours. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required. Systems shall then be drained, filled and flushed with clean water until no foreign matter is observed and total alkalinity of rinse water is equal to that of the make up water.
- G. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect/Engineer.
- H. Flush systems with clean water for one hour minimum. Drain completely and refill.
- I. Remove, clean, and replace strainer screens.
- J. Each system shall be properly treated to prevent scaling and corrosion.
- K. The water treatment service company currently under contract with the owner shall provide the flushing, cleaning and chemical treatment process.

- L. All cost associated with this service and certification shall be paid by the Contractor as a basic part of this project.

*** END OF SECTION 23 21 13 ***

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SECTION 23 21 23 - HYDRONIC PUMPS

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. Base-mounted, end-suction centrifugal pumps.

1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 1. Include installation instructions, assembly views, lubrication instructions, and replacement parts list.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. Qualifications: The Manufacturer shall have a local, trained representative with a full field service support office within 50 miles of the job site. The service support office shall have stock inventory items and service personnel specifically trained to install, check- out, align, and service pumps produced by the manufacturer.
- C. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum five years experience.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

- E. 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.
- F. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location. Rotate shaft on stored pumps every three months or as required by manufacturer on pumps on site.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide one extra set of mechanical seals and a complete set of gaskets for each pump installed on this project.

1.9 WARRANTY

- A. Provide one year manufacturer's warranty under provisions of Division 1.
- B. In addition to the manufacturer's basic one year warranty, provide all parts , next day parts shipping costs, additional alignment services, motor replacement and labor, as necessary for repairs of a failed pump during the warranty period, at no additional cost to the Owner.
- C. EXTENDED WARRANTY: Provide an extended warranty to extend upon completion of year one through year five. The warranty shall cover materials that prove defective within the extended period.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design— ITT-Bell & Gossett.
- B. Pre-approved Substitutes (Approved to Bid)

1. TACO.
2. Armstrong.
3. Proposed Substitutes.
4. All pre-approved substitutes and proposed substitutes shall submit, at a minimum, the following information prior to bid, to the Architect/Engineer in addition to the requirements as required by the Specification Section 15010. Accepted substitutes other than the Basis of Design and the Pre-Approved Substitutes will be notified via written addendum.
 - a. All pump curves, specifically identifying all proposed options.
 - b. Each selected motor horsepower and its' duty rating and efficiency rating.
 - c. Pump dimensions and weights.
 - d. 1/4 scale floor plan layout sketch of pump/mechanical room with actual substitute pump sizes and the manufacturers recommended clearances.
 - e. Give a written list of significant distinguishable differences between the Basis of Design pump and the substitute pump.
 - f. Describe how the substitute pump will be provided with factory certified start-up and warranty service. Specify all 1st, 2nd and 3rd parties (company names and personnel) which will be involved in the delivery of said service. Specify location, distance from jobsite, anticipated response times, etc., for delivery of said service.
 - g. Describe the details of all spare parts for the substitute pump which will be housed locally (within 50 miles) or describe the method of next day parts delivery for replacement parts. State the party responsible for the complete coverage of shipping costs, parts costs, and labor costs during the warranty period (required for corrective action for a failed pump), if it is a party other than this pump manufacturer's representative.

2.2 GENERAL CONSTRUCTION REQUIREMENTS

- A. Balance: Rotating parts, statically and dynamically.
- B. Construction: To permit servicing without breaking piping or motor connections.
- C. Pump Motors: Operate at 1750 rpm unless specified otherwise on drawings.
- D. Pump Connections: Flanged-Provide flat faced matching flanges as required.
- E. All pump motors shall be totally-enclosed fan cooled (TEFC).
- F. All HVAC pump motors shall be IEEE rated energy efficient, high efficiency motors and shall comply with Specification Section 15170.
- G. All HVAC pump motors designated for variable frequency drive (VFD) duty shall be VFD compatible motors and be inverter duty rated.

- H. Provide a pump selection (i.e. model #) which will allow for the installation of a larger impeller than that required to meet the GPM and static head characteristics listed on the pump schedule. Pump selection shall allow for an increased size impeller (minimum ¼" larger diameter) to be installed within the same pump casing.

2.3 BASE MOUNTED END SUCTION PUMPS

- A. Type: Horizontal, close-coupled, vertical split case, centrifugal pump of cast iron or steel, for 125 psig maximum working pressure.
- B. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- C. Impeller: Stainless steel, fully enclosed, keyed to motor shaft, dynamically balanced.
- D. Bearings: Permanently lubricated roller or ball bearings.
- E. Shaft: Carbon steel shaft, stainless steel key locked shaft sleeve, 'O' ring sealed from pumped liquid. Wetted shaft pumps are not accepted unless otherwise noted on the Pump Schedule.
- F. Seal: Stainless steel mechanical seal with Buna-N elastomers, Ni - Resist seat and Carbon Washers.
- G. Baseplate: Cast iron or fabricated steel with integral drain rim.
- H. Motor Requirements
 - 1. Motors in NEMA frames 143T through 445T shall be 3 phase, 60 hertz, 230/460 volts.
 - 2. Motors shall be suitable for continuous duty in ambient temperatures from -30°C to 40°C at rated service factor. Altitude shall be less than 3,300'.
 - 3. All motors shall have a service factor of 1.15.
 - 4. All motors shall be capable of developing NEMA Design B locked rotor and pull up torque with 90% of rated voltage applied.
 - 5. The insulation system must be Class "F" or better with Class "B" rise at service factor 1.15 (90°C).
 - 6. Dual voltage motors 7.5 HP and larger must be capable of ATL and WYE-Delta starting on both voltages and part winding starting on the lower voltage.
 - 7. Stator frame and end brackets shall be cast iron construction.
 - 8. Bearings shall be either ball or cylindrical roller bearings.
 - 9. Bearings shall be selected to provide an L-10 rated life of 30,000 hours with external load factors per NEMA MG1-14.42.
 - 10. Frames 256T and smaller shall use sealed bearings. Frames 284T and larger shall be regreasable while motor is operating.
 - 11. All hardware shall be zinc-dichromate plated.

12. Nameplates shall be 304 stainless steel.
13. All motors shall have a neoprene gasket between the conduit box and the motor frame.
14. All motors to be dynamically balanced to 0.6 mils peak to peak or better.
15. Motors called out on the pump schedules to be multi-speed shall be 1800/900 RPM, 4 pole/8 pole, variable torque type with two (2) windings (single winding motors not acceptable).
16. Applicable Standards and Test:
 - a. NEMA Publication MG-1.
 - b. Testing per NEMA MG-1-12.53a (IEEE Test Standard, Method B with segregated loss analysis).
 - c. All motors shall be given a routine test per NEMA MG-1, Section 12.51.
 - d. UL Recognition and CSA listings are required. The nameplate shall be stamped accordingly.
 - e. Frame assignments shall be per NEMA MG-13.

2.4 PUMP COUPLING SCHEDULE

A. Pump Coupling Sizes for 1750 RPM Motors.

MOTOR HP	MOTOR FRAME	MOTOR RPM	STANDARD COUPLING SIZE	VFD COUPLING SIZE
1	143T	1750	3	4
1.5	145T	1750	3	4
2	145T	1750	4	5
3	182T	1750	4	5
5	184T	1750	5	6
7.5	213	1750	6	7
10	215T	1750	6	7
15	254T	1750	7	8
20	256T	1750	7	8
25	284T	1750	8	9
30	286T	1750	8	9
40	324T	1750	9	10
50	326T	1750	9	10
60	364T	1750	10	10

B. Pump Coupling Sizes for 1150 RPM Motors.

MOTOR HP	MOTOR FRAME	MOTOR RPM	STANDARD COUPLING SIZE	VFD COUPLING SIZE
5	215T	1150	6	7
7.5	254T	1150	7	8
10	256T	1150	7	8
15	284T	1150	8	9
20	286T	1150	8	9

2.5 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser: Angle pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 23 Section "Common Work Results for HVAC."
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 PUMP INSTALLATION

- A. Comply with Hydraulic Institute Standard 1.4.

- B. Install pumps in accordance with manufacturer's instructions.
- C. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- D. Contractor shall provide and grout the base of all pumps as recommended by the pump manufacturer.
- E. Decrease from line size with long radius reducing elbows or eccentric reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Refer to Section 15140.
- F. Provide air cock and drain connection on horizontal pump casings.
- G. Provide drains for bases and seals, piped to and discharging into floor drains.
- H. Lubricate pumps before start-up.
- I. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- J. Install continuous-thread hanger rods and elastomeric hangers or spring hangers of sufficient size to support pump weight. Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- K. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
 - 1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
 - 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.
- L. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- M. This Contractor shall provide, as a part of the Base Bid, impeller shaving on all pumps 7½ HP and larger (all other pumps shall be installed with impellers sized per the pump schedule). Impeller shaving shall occur upon approval of the T&B agents recommendations. This Contractor shall coordinate this effort with the Owner/Engineer and the machine shop so as to minimize the downtime of the pump(s) and disruption to the building occupants.

3.4 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.

- C. Adjust pump and motor shafts for angular and offset alignment by methods specified in Hydraulic Institute Standard 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation." Provide start-up service from the Manufacturer's Representative, which shall include the alignment of the pump coupling for all pumps. Laser alignment shall be completed for pumps 20 HP and larger
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install check valve and isolation valve on discharge side of all pumps.
- F. Install calibrated balance valve on discharge side of all constant volume pumps.
- G. Install suction diffuser and shutoff valve on suction side of all heating and cooling pumps
- H. Install Y-strainers and shutoff valve on suction side of condenser pumps.
- I. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- J. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve. Refer to detail on drawings.
- K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.

4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.
- B. Provide a 3-plane vibration test for all pumps 20 HP and larger. Contractor shall submit three copies of test results to the Engineer for review. All vibration testing shall be provided by a third party, Certified in 3-plane vibration testing.
- C. Start-up Certificate: Submit the start-up certificate to the Architect/Engineer within seven days from the day of start-up. A copy of the start-up certificate shall be available on-site, the day the start-up is complete, and remain available at the site for the duration of the project.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01 Section "Demonstration and Training."

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SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section .

1.2 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-22:
 - 1. Suction Lines for Air-Conditioning Applications: 185 psi.
 - 2. Suction Lines for Heat-Pump Applications: 325 psig.
 - 3. Hot-Gas and Liquid Lines: 325 psig.
- B. Line Test Pressure for Refrigerant R-134a:
 - 1. Suction Lines for Air-Conditioning Applications: 115 psig.
 - 2. Suction Lines for Heat-Pump Applications: 225 psig.
 - 3. Hot-Gas and Liquid Lines: 225 psig.
- C. Line Test Pressure for Refrigerant R-407C:
 - 1. Suction Lines for Air-Conditioning Applications: 230 psig.
 - 2. Suction Lines for Heat-Pump Applications: 380 psig.
 - 3. Hot-Gas and Liquid Lines: 380 psig.
- D. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 535 psig.
 - 3. Hot-Gas and Liquid Lines: 535 psig.

1.4 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Thermostatic expansion valves.
 - 2. Solenoid valves.
 - 3. Hot-gas bypass valves.
 - 4. Filter dryers.
 - 5. Strainers.
 - 6. Pressure-regulating valves.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Shop Drawing Scale: 1/4 inch equals 1 foot .
 - 2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Welding certificates.
- D. Field quality-control test reports. Reports shall indicate results of leak test, acid test.
- E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.
- B. Deliver and store piping and specialties in shipping containers with labeling in place.

- C. Deliver, store, and protect products under provisions of Basic Mechanical Requirements, General Conditions, and Supplementary General Conditions.

1.7 COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 degF.

2.2 VALVES AND SPECIALTIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Henry Valve Co.
 - 2. Sporlan Valve Co.
 - 3. Danfoss, Inc.
- B. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.

2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 degF.

C. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 degF.

D. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 degF.

E. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.

3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig.
- F. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
 6. Working Pressure Rating: 400 psig.
 7. Maximum Operating Temperature: 240 degF.
 8. Manual operator.
- G. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat Disc: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig.
 6. Maximum Operating Temperature: 240 degF.
- H. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: 40 degF.
 6. Superheat: Adjustable.
 7. Reverse-flow option (for heat-pump applications).

8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 450 psig.
- I. Hot-Gas Bypass Valves: Comply with UL429; listed and labeled by an NRTL.
 1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 5. Seat: Polytetrafluoroethylene.
 6. Equalizer: External.
 7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
 8. End Connections: Socket.
 9. Throttling Range: Maximum 5 psig.
 10. Working Pressure Rating: 500 psig.
 11. Maximum Operating Temperature: 240 degF.
- J. Straight-Type Strainers:
 1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig.
 5. Maximum Operating Temperature: 275 degF.
- K. Angle-Type Strainers:
 1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig.
 6. Maximum Operating Temperature: 275 degF.

- L. Moisture/Liquid Indicators:
 - 1. Body: Forged brass.
 - 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 - 3. Indicator: Color coded to show moisture content in ppm.
 - 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 - 5. End Connections: Socket or flare.
 - 6. Working Pressure Rating: 500 psig.
 - 7. Maximum Operating Temperature: 240 degF.
 - 8. Indicator shall be line size sweat type for liquid lines 2-1/8 inches O.D. and smaller.
- M. Liquid Accumulators: Comply with ARI495.
 - 1. Body: Welded steel with corrosion-resistant coating.
 - 2. End Connections: Socket or threaded.
 - 3. Working Pressure Rating: 500 psig.
 - 4. Maximum Operating Temperature: 275 degF.

2.3 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Atofina Chemicals, Inc.
 - 2. DuPont Company; Fluorochemicals Div.
 - 3. Honeywell, Inc.; Genetron Refrigerants.
 - 4. INEOS Fluor Americas LLC.
- B. ASHRAE 34, R-22: Monochlorodifluoromethane.
- C. ASHRAE 34, R-134a: Tetrafluoroethane.
- D. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.
- E. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 EXECUTION

3.1 PIPING APPLICATIONS

- A. Lines NPS 7/8 and Smaller for Conventional Air-Conditioning Applications: Copper, Type L, annealed-temper tubing and wrought-copper fittings with soldered joints.
- B. Lines NPS greater than 7/8 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top. Valves with port size less than 1/4 inch may be direct operated. Valves 1/4 inch and larger shall be pilot operated. All shall have manual lift stems. Valves shall be selected in accordance with Manufacturer's published data. Systems using refrigerant 12 shall be limited to 2 psig drop through valve and 3 psig for those using 22 or 502. Valves shall have sweat connections for lines 1-1/8 inches O.D. and smaller. When lines larger than 1-1/8 inches O.D. are required they shall be flanged.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- K. Install receivers sized to accommodate pump-down charge.
- L. Install flexible connectors at compressors.
- M. Install refrigeration specialties in accordance with manufacturer's instructions.
- N. Provide non-conducting dielectric connections when joining dissimilar metals.
- O. All piping shall be sized in accordance with the equipment (i.e., remote condenser/chiller or split system) manufacturer's recommendations and limitations. These shall include pressure drop, length of run, lift, etc. Equipment manufacturer shall provide field coordination and shop drawings on all units exceeding 25 tons, 75 feet of equivalent length pipe (one way), or exceeding 20 feet lift.

3.3 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 to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- Q. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- S. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- T. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- U. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."
- V. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- W. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.

2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

*** END OF SECTION 23 23 00 ***

SECTION 23 25 00 - HVAC WATER TREATMENT

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 HVAC water-treatment systems:
 - 1. Bypass chemical-feed equipment and controls.
 - 2. Chemical treatment test equipment.
 - 3. HVAC water-treatment chemicals.
 - 4. Makeup water softeners.
 - 5. Water filtration units for HVAC makeup water.

1.3 DEFINITIONS

- A. EEPROM: Electrically erasable, programmable read-only memory.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- C. RO: Reverse osmosis.
- D. TDS: Total dissolved solids.
- E. UV: Ultraviolet.

1.4 PERFORMANCE REQUIREMENTS

- A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.
- B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- C. Closed hydronic systems, including [hot-water heating] [chilled water] [dual-temperature water] [and] [glycol cooling], shall have the following water qualities:
 - 1. pH: Maintain a value within 9.0 to 10.5.
 - 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.

3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TDS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
 - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
 - d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
 - e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

1.5 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
 1. Bypass feeders.
 2. Water meters.
 3. Inhibitor injection timers.
 4. pH controllers.
 5. TDS controllers.
 6. Biocide feeder timers.
 7. Chemical solution tanks.
 8. Injection pumps.
 9. Ozone generators.
 10. UV-irradiation units.
 11. Chemical test equipment.
 12. Chemical material safety data sheets.
 13. Water softeners.

14. RO units.
 15. Multimedia filters.
 16. Self-cleaning strainers.
 17. Bag- or cartridge-type filters.
 18. Centrifugal separators.
- B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: Power and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.
- E. Other Informational Submittals:
1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
 2. Water Analysis: Illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.
- 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.

1.7 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping, heating, hot-water piping piping, condenser-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
1. Initial water analysis and HVAC water-treatment recommendations.
 2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 3. Periodic field service and consultation.

4. Customer report charts and log sheets.
5. Laboratory technical analysis.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- 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. R2J Chemical Services.
 2. Anderson Chemical Co, Inc.
 3. Aqua-Chem, Inc.; Cleaver-Brooks Div.
 4. Barclay Chemical Co.; Water Management, Inc.
 5. Boland Trane Services
 6. GE Betz.
 7. GE Osmonics.
 8. H-O-H Chemicals, Inc.
 9. Metro Group. Inc. (The); Metropolitan Refining Div.
 10. ONDEO Nalco Company.
 11. Watcon, Inc.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel. Provide feeders with side stream 5 micron bag filter with a minimum of 2 spare replacement bags. Rotate a clean bag into service each month. Clean and dry removed bag for use in rotation. Continue rotation for first 6 month or until owners water treatment contractor takes over maintenance. Insulate inlet and outlet piping from system piping to feeders. Provide inlet and outlet shut-off valves and calibrated balance valve. Refer to detail on drawings.
 1. Capacity: 5 gal.

2. Minimum Working Pressure: 175 psig.

2.3 STAINLESS STEEL PIPES AND FITTINGS

- A. Stainless-Steel Tubing: Comply with ASTM A 269, Type 316.
- B. Stainless-Steel Fittings: Complying with ASTM A 815/A 815M, Type 316, Grade WP-S.
- C. Three-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, threaded body design with adjustable stem packing, threaded ends, and 150-psig SWP and 600-psig CWP rating.
- D. Controls: Interlock with pumps to operate when water is circulating.

2.4 CHEMICAL TREATMENT TEST EQUIPMENT

- A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.
- B. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
 1. Two-station rack for closed-loop systems.
 2. Four-station rack for open systems.

2.5 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.
- B. Water Softener Chemicals:
 1. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock. Resin exchange capacity minimum 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lb of salt.
 2. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are not acceptable.

PART 3 EXECUTION

3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install water testing equipment on wall near water chemical application equipment.
- C. Install interconnecting control wiring for chemical treatment controls and sensors.
- D. Mount sensors and injectors in piping circuits.
- E. Bypass Feeders: Install in closed hydronic systems, including hot-water heating and chilled water, and equipped with the following:
 - 1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 2. Install water meter in makeup water supply.
 - 3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
 - 5. Install a swing check on inlet after the isolation valve.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Common Work Results for HVAC."
- D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- E. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.
- F. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
- G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
 - 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.
- B. Tests and Inspections:
 - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
 - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
 - 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
 - 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 - 5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 7. 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 test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
 - 8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. For one year, sample boiler water at six week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.
- E. Comply with ASTM D 3370 and with the following standards:
 - 1. Silica: ASTM D 859.
 - 2. Steam System: ASTM D 1066.
 - 3. Acidity and Alkalinity: ASTM D 1067.

4. Iron: ASTM D 1068.
5. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Division 01 Section "Demonstration and Training."
- B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

*** END OF SECTION 23 25 00 ***

SECTION 23 29 23 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

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 solid-state, PWM, VFCs for speed control of three-phase, squirrel-cage induction motors.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical Power Monitoring and Control" for monitoring and control of motor circuits.
 - 2. Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" for low-voltage power, control, and communication surge suppressors.

1.3 DEFINITIONS

- A. BMS: Building management system.
- B. IGBT: Integrated gate bipolar transistor.
- C. LAN: Local area network.
- D. PID: Control action, proportional plus integral plus derivative.
- E. PWM: Pulse-width modulated.
- F. VFC: Variable frequency controller.

1.4 SUBMITTALS

- A. Product Data: For each type of VFC. Include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.
- B. Shop Drawings: For each VFC.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.

- c. Short-circuit current rating of integrated unit.
 - d. Listed and labeled for series rating of overcurrent protective devices in combination controllers by an NRTL acceptable to authorities having jurisdiction.
 - e. Features, characteristics, ratings, and factory settings of each motor-control center unit.
- 2. Wiring Diagrams: Power, signal, and control wiring for VFCs. Provide schematic wiring diagram for each type of VFC.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs where pipe and ducts are prohibited. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Manufacturer Seismic Qualification Certification: Submit certification that VFCs, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Qualification Data: For manufacturer.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for VFCs and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- H. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

- I. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.
- D. 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.
- E. Comply with NFPA 70.
- F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, minimum clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver VFCs in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.
- B. Store VFCs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFCs from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. If stored in areas subject to weather, cover VFCs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
 1. Ambient Temperature: 0 to 40 deg C.
 2. Humidity: Less than 90 percent (noncondensing).

3. Altitude: Not exceeding 3300 feet.
- B. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Owner no fewer than twodays in advance of proposed interruption of electrical service.
 2. Indicate method of providing temporary electrical service.
 3. Do not proceed with interruption of electrical service without Owner's written permission.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.8 COORDINATION

- A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. 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."
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."
- D. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- E. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
 2. Indicating Lights: Two of each type installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB.
 - 2. Danfoss.
 - 3. Yaskawa.
 - 4. OTHER SUBSTITUTES—Submit a written substitution request, prior to bid, to the Architect/Engineer in accordance with Division 23 Section “Common Work Results for HVAC”. Accepted substitutes will be notified via Addendum.

2.2 VARIABLE FREQUENCY CONTROLLERS

- A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
- B. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.
- C. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- D. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- E. Unit Operating Requirements:
 - 1. Input ac voltage tolerance of plus or minus 10 percent.
 - 2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
 - 3. Minimum Efficiency: 96 percent at 60 Hz, full load.
 - 4. Minimum Displacement Primary-Side Power Factor: 96 percent.
 - 5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
 - 6. Starting Torque: 100 percent of rated torque or as indicated.
 - 7. Speed Regulation: Plus or minus 1 percent.

- F. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
 - 1. Electrical Signal: 4 to 20 mA at 24 V.
- G. Internal Adjustability Capabilities:
 - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3. Acceleration: 2 to a minimum of 22 seconds.
 - 4. Deceleration: 2 to a minimum of 22 seconds.
 - 5. Current Limit: 50 to a minimum of 110 percent of maximum rating.
- H. Self-Protection and Reliability Features:
 - 1. Input transient protection by means of surge suppressors.
 - 2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
 - 3. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class [10] [20] [30] performance.
 - 4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
 - 5. Instantaneous line-to-line and line-to-ground overcurrent trips.
 - 6. Loss-of-phase protection.
 - 7. Reverse-phase protection.
 - 8. Short-circuit protection.
 - 9. Motor overtemperature fault.
- I. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.
- J. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
- K. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
- L. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

- M. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- N. Input Line Conditioning: 3%.
- O. Provide a DV/DT filter to provide motor protection from the VFD. Output filter shall have the following characteristics and shall provide common mode reduction, peak voltage protection, and rise time reduction, all in one unit:

DV/DT filter shall be Model DV Sentry filter by MTE.

Input Voltage..... 380V – 600V, 50/60 Hz

Current Range 3A – 600A

Available Form Factors..... Panel
NEMA 1/2
NEMA 3R

Max Peak Motor Voltage 150% of DC bus voltage at 1000 feet

Rise Time..... Less than 0.1uS

Insertion Loss No more than 1.7% at 60 Hz
No more than 2.6% at 90 Hz

Intermittent Current Ratings 150% continuous RMS (1 minute)
200% continuous RMS (10 seconds)

Carrier Frequency Range 3A – 110A: 900 Hz – 10kHz
(up to 14 kHz with de-rating)
130A – 600A: 900 Hz – 5kHz

Motor Frequency..... Up to 90 Hz without de-rating
Up to 120 Hz with de-rating

Agency Approvals..... UL, cUL, CE, and RoHS

Motor Audible Noise Less than 65 dB

Service Temperature Enclosed -40C to 50C
Open -40C to 60C

Warranty THREE years from the date of shipment

- P. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.

5. Overcurrent.
 6. External fault.
- Q. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
- R. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (VDC).
 9. Set-point frequency (Hz).
 10. Motor output voltage (V).
- S. Control Signal Interface:
1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
 - a. 0 to 10-V dc.
 - b. 0-20 or 4-20 mA.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 - e. RS485.
 - f. Keypad display for local hand operation.

3. Output Signal Interface:
 - a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
 - 1) Output frequency (Hz).
 - 2) Output current (load).
 - 3) DC-link voltage (VDC).
 - 4) Motor torque (percent).
 - 5) Motor speed (rpm).
 - 6) Set-point frequency (Hz).
4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set-point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.
- T. Communications: Provide an RS485 interface allowing VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.
- U. Manual Bypass: VFD shall contain a 3-contactor bypass or 2-contactor bypass to line circuitry in the same cabinet as the VFD components. Electronic bypass is accepted. Magnetic contactor arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable operation (starting, stopping, and running), with motor completely disconnected from controller (no load).
- V. Bypass Controller: NEMA ICS 2, full-voltage, nonreversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
- W. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.
- X. Isolating Switch: Non-load-break switch arranged to isolate VFC and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
- Y. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

2.3 ENCLOSURES

- A. NEMA 1.

2.4 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
- C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- D. Control Relays: Auxiliary and adjustable time-delay relays.
- E. Standard Displays:
 - 1. Output frequency (Hz).
 - 2. Set-point frequency (Hz).
 - 3. Motor current (amperes).
 - 4. DC-link voltage (VDC).
 - 5. Motor torque (percent).
 - 6. Motor speed (rpm).
 - 7. Motor output voltage (V).
- F. Historical Logging Information and Displays:
 - 1. Real-time clock with current time and date.
 - 2. Running log of total power versus time.
 - 3. Total run time.
 - 4. Fault log, maintaining last four faults with time and date stamp for each.
- G. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.5 FACTORY FINISHES

- A. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested VFCs before shipping.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.
- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. Anchor each VFC assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.
- B. Install VFCs on concrete bases.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- D. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Common Work Results for Electrical," and concrete materials and installation requirements are specified in Division 03.

3.5 IDENTIFICATION

- A. Identify VFCs, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.6 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Assist in field testing of equipment[including pretesting and adjusting of solid-state controllers.
 - 3. Report results in writing.
- C. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- D. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- E. Perform the following field tests and inspections and prepare test reports:

- F. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
 - 1 Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.9 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. Refer to Division 01 Section "Demonstration and Training."

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SECTION 23 31 13 - METAL DUCTS

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. Double-wall rectangular ducts and fittings.
3. Kitchen Hood Grease Duct
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. 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-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
 1. Liners and adhesives.
 2. Sealants and gaskets.

3. Seismic-restraint devices.
- B. LEED Submittals (if required):
1. Product Data for Prerequisite EQ1: Documentation indicating that duct systems comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
 2. Product Data for Prerequisite EA2: Documentation indicating that duct systems comply with ASHRAE/IESNA90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."
 3. Leakage Test Report for Prerequisite EA2: Documentation of work performed for compliance with ASHRAE/IESNA90.1-2004, Section 6.4.4.2.2 - "Duct Leakage Tests."
 4. Duct-Cleaning Test Report for Prerequisite EQ1: Documentation of work performed for compliance with ASHRAE 62.1-2004, Section 7.2.4 - "Ventilation System Start-Up."
 5. Product Data for Credit EQ4.1: For adhesives and sealants, including printed statement of VOC content.
- C. Shop Drawings:
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 and vibration isolation.
- D. Delegated-Design Submittal:
1. Sheet metal thicknesses.

2. Joint and seam construction and sealing.
 3. Reinforcement details and spacing.
 4. Materials, fabrication, assembly, and spacing of hangers and supports.
- E. 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.
 - f. Perimeter moldings.
- F. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

1.6 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

- B. Low Pressure: Three pressure classifications:
 - 1. 1/2 inch WG positive or negative static pressure and velocities less than 2,000 fpm;
 - 2. 1 inch WG positive or negative static pressure and velocities less than 2,500 fpm; and
 - 3. 2 inch WG positive or negative static pressure and velocities less than 2,500 fpm.
- C. Medium Pressure: Two pressure classifications:
 - 1. 3 inch WG positive or negative static pressure and velocities less than 4,000 fpm; and
 - 2. 4 inch WG positive static pressure and velocities less than 4,000 fpm.

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 1-4, "Transverse (Girth) 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 1-5, "Longitudinal Seams - Rectangular Ducts," 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 2, "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 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. McGill AirFlow LLC.
 - 2. Sheet Metal Connectors, Inc.
 - 3. Metal Mart
 - 4. Express Metals.

5. Eastern Sheet Metal
 6. Commercial Duct Systems
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) 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."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," 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."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMAAH124, "Fibrous Glass Duct Liner Standard."
1. Insulation shall be fiberglass that is 1" thick acoustical duct liner rated for 6,000 fpm air velocity, 250 °F maximum operating temperature, and shall be applied to the inner surface of the outer shell using duct liner adhesive.
 2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x degF at 75 degF mean temperature. Installed duct shall have a minimum R-4.2 Thermal Insulation Rating.
 3. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 4. Insulation shall meet antimicrobial resistant requirements.
 5. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch diameter perforations, with overall open area of 23 percent.
- H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) 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."
- I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," 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."
- J. Provide access doors on supply and return; 6-8 feet from the unit; minimum size 18"x18" and at 10 foot intervals to the end of the 40 foot length.

- K. Ductwork Shop Drawings/Field Coordination: All double wall ductwork shall be factory premanufactured (fittings and straight lengths). As a basic part of this manufacturer's contractual requirements, they shall provide a minimum ¼" per foot, scaled, coordinated, ductwork shop drawings (coordination drawings). The coordination drawings shall be field verified by a certified manufacturer's representative and the installing contractor(s). The coordination drawings shall represent the actual routing, mounting locations, transitions, etc., as necessary to achieve the design intent while optimizing the use of the designated installation space as it relates to equipment and materials of other trades in that space (i.e., piping, air handlers, starters, building structure, electrical panels, etc). These coordination drawings shall be submitted to the Engineer for review and approval prior to ordering materials. These coordination drawings shall be submitted to the Engineer no later than four (4) weeks after the contract between Owner and Contractor is signed.

2.3 DOUBLE-WALL FACTORY FABRICATED GREASE DUCT

- A. Provide ductwork in accordance with NFPA -96, Standard for Ventilation, Control, and Fire Protection of Commercial Cooking Operations, and Florida Building Code, Mechanical, Grease Hood Duct Systems.
- B. Exhaust outlets for ducts serving commercial food cooking and processing equipment shall terminate outside the building and shall be located 10 feet from any adjacent building, parking area, adjacent property line, window, door, or air intake opening and shall be located at least 10 feet above the adjoining grade level. Every exhaust outlet which is located above the roof shall terminate at least 40 inches above the roof surface.
- C. Grease Duct Enclosure
1. 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:
 - a. American Metal Products; MASCO Corporation.
 - b. Metal-Fab, Inc.
 - c. Schebler Co. (The).
 - d. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
 - e. Van-Packer Company, Inc.
 2. Description: Double-wall metal vents tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.
 3. Construction: Inner shell and outer jacket separated by at least a 3-inch annular space filled with high-temperature, ceramic-fiber insulation.
 4. Inner Shell: ASTM A 666, stainless steel.
 5. Outer Jacket: stainless steel.

6. Accessories: Tees, elbows, increasers, hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters and drain fittings.

2.4 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 A653/A653M.
 1. Galvanized Coating Designation: Interior Ductwork:G60 (Z180); Exterior Ductwork: G90 (Z275).
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No.2B, No.2D, No.3, or No.4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Factory- or Shop-Applied Antimicrobial Coating:
 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D3363.
 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 5. Shop-Applied Coating Color: Black.
 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- G. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

- H. 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.

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NA1MAAH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Maximum Thermal Conductivity:
 - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x degF at 75 degF mean temperature.
 - 2) Type II, Rigid: [0.23 Btu x in./h x sq. ft. x degF] at 75 degF mean temperature.
2. 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.
3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Foster 85-60
 - b. Childers CP-127
 - 1) For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40CFR59, SubpartD (EPA Method24). Adhesives documentation indicating that products 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. 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 2-19, "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. Apply adhesive coating on longitudinal seams in ducts.
 7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
 8. 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.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
 9. Terminate inner ducts with build-outs attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated build-outs (metal hat sections) or other build-out means are optional; when used, secure build-outs to duct walls with bolts, screws, rivets, or welds.

2.6 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. Water-Based Joint and Seam Sealant:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster 32-19
 - b. Childers CP-146
 - c. RCD #8
2. Application Method: Brush on.
3. Solids Content: Minimum 65 percent.
4. ShoreA Hardness: Minimum 20.
5. Water resistant.
6. Mold and mildew resistant.
7. VOC: Maximum 75g/L (less water).
8. Maximum Static-Pressure Class : 10-inch wg, positive and negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Solvent-Based Joint and Seam Sealant:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster 32-14
 - b. Childers CP-140
2. Application Method: Brush on.
3. Base: Synthetic rubber resin.
4. Solvent: Toluene and heptane.
5. Solids Content: Minimum 60 percent.
6. ShoreA Hardness: Minimum 60.
7. Water resistant.
8. Mold and mildew resistant.
9. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40CFR59, SubpartD (EPA Method24).

10. VOC: Maximum 395g/L.
 11. Maximum Static-Pressure Class : 10-inch wg, positive or negative.
 12. Service: Indoor or outdoor.
 13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type : S.
 3. Grade: NS.
 4. Class : 25.
 5. Use: O.
 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40CFR59, SubpartD (EPA Method24).
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. 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.

2.7 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 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.
- F. 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.

- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

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. Provide a minimum ¼" per foot, scaled, coordinated, ductwork shop drawings (coordination drawings). The coordination drawings shall represent the actual routing, mounting locations, transitions, etc., as necessary to achieve the design intent while optimizing the use of the designated installation space as it relates to equipment and materials of other trades in that space (i.e., piping, air handlers, starters, building structure, electrical panels, etc). These coordination drawings shall be submitted to the Engineer for review and approval prior to ordering materials. These coordination drawings shall be submitted to the Engineer no later than four (4) weeks after the contract between Owner and Contractor is signed.
- B. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- C. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- 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.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

- K. 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.
- L. 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.
- M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

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."
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class A.
 - 4. Outdoor, Return-Air Ducts: Seal Class A.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class A.
 - 8. Unconditioned Space, Return-Air Ducts: Seal Class A.
 - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.
 - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.

11. Conditioned Space, Exhaust Ducts: Seal Class A.
12. Conditioned Space, Return-Air Ducts: Seal Class A.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "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. 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 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "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:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
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 50 percent of total installed duct area for each designated pressure class.
 - b. Ducts with a Pressure Class of 2-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.
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' advance 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 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

- A. All Air Handlers (first 20 feet on supply side of unit connection): 4 inch WG positive static pressure and velocities less than 4,000 fpm. Test duct leakage in accordance with Seal Class A.

- B. All Air Handlers (first 20 feet on return side of unit connection): 3 inch WG negative static pressure and velocities less than 4,000 fpm. Test duct leakage in accordance with Seal Class A.
- C. Return Ductwork: 1 inch negative static pressure and velocities less than 2,500 fpm. Seal ductwork in accordance with Seal Class A. Testing may not be required if deemed acceptable by the Engineer during construction. Test duct leakage in accordance with Seal Class C.
- D. Exhaust Ductwork and Outside Air Ductwork: 1 inch positive or negative static pressure and velocities less than 2,500 fpm. Seal ductwork in accordance with Seal Class A. Testing may not be required if deemed acceptable by the Engineer during construction. Test duct leakage in accordance with Seal Class C.
- E. Transfer Ductwork: 1/2 inch positive or negative static pressure and velocities less than 2,000 fpm. Seal ductwork in accordance with Seal Class A. Testing may not be required if deemed acceptable by the Engineer during construction. Test duct leakage in accordance with Seal Class C.
- F. Fabricate ducts as follows:

AIR SYSTEM	MATERIAL
Low Pressure Supply	Galvanized Steel
Medium Pressure Supply	Galvanized Steel
Return and Relief	Galvanized Steel
General Exhaust	Galvanized Steel
Outside Air Intake	Galvanized Steel
Emergency Exhaust	Galvanized Steel
Shower Room Exhaust	Aluminum
Kitchen Hood Exhaust	(Refer to Double-wall Factory Fabricated Grease Duct, this section)

- G. Supply Ducts:
- Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - Pressure Class : Positive 1-inch wg.
 - Minimum SMACNA Seal Class : A.
 - SMACNA Leakage Class for Rectangular: 24.
 - SMACNA Leakage Class for Round and Flat Oval: 12.
 - Ducts Connected to Air-Handling Units for the first fifteen (15) feet:
 - Type : Double-wall ductwork
 - Pressure Class : Positive 4-inch wg.

- c. Minimum SMACNA Seal Class : A.
 - d. SMACNA Leakage Class for Rectangular: 6.
 - e. SMACNA Leakage Class for Round and Flat Oval: 3.
 - 3. Ducts Connected to Air-Handling Units after the first fifteen (15) feet:
 - a. Type: Single wall
 - b. Pressure Class : Positive 2-inch wg.
 - c. Minimum SMACNA Seal Class : A.
 - d. SMACNA Leakage Class for Rectangular: 12.
 - e. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 4. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class : Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class : A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- H. Return Ducts:
- 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class : Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class : A.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12
 - 2. Ducts Connected to Air-Handling Units for the first fifteen (15) feet:
 - a. Type : Double-wall ductwork
 - b. Pressure Class : Positive or negative 3-inch wg.
 - c. Minimum SMACNA Seal Class : A.
 - d. SMACNA Leakage Class for Rectangular: 12.
 - e. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 3. Ducts Connected to Air-Handling Units after the first fifteen (15) feet:
 - a. Type: Single wall

- b. Pressure Class : Positive or negative 2-inch wg (500 Pa).
 - c. Minimum SMACNA Seal Class : A.
 - d. SMACNA Leakage Class for Rectangular: 12.
 - e. SMACNA Leakage Class for Round and Flat Oval: 6.
- 4. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class : Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class : A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- I. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE62.1, Class 1 and 2) Air:
 - a. Type: Single wall, lined ductwork
 - b. Pressure Class : Negative 1-inch wg.
 - c. Minimum SMACNA Seal Class : A.
 - d. SMACNA Leakage Class for Rectangular: 24.
 - e. SMACNA Leakage Class for Round and Flat Oval: 12.
 - 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class : Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class : A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Pressure Class : Positive or negative 2-inch wg.
 - b. SMACNA Leakage Class : 3.
 - 4. Ducts Connected to Fans Exhausting Moist/Wet Air from Shower Rooms:
 - a. Aluminum metal, unlined duct.
 - b. Pressure Class : Negative 1-inch wg.
 - c. Minimum SMACNA Seal Class : A.

- d. SMACNA Leakage Class for Rectangular: 24.
 - e. SMACNA Leakage Class for Round and Flat Oval: 12
 - 5. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class : Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- J. Transfer Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE62.1, Class 1 and 2) Air:
 - a. Type: Single wall, lined ductwork
 - b. Pressure Class : Negative 1-inch wg.
 - c. Minimum SMACNA Seal Class : A.
 - d. SMACNA Leakage Class for Rectangular: 24.
 - e. SMACNA Leakage Class for Round and Flat Oval: 12.
- K. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 - 1. Ducts Connected to Fan Coil Units, Heat Pumps, and Terminal Units:
 - a. Pressure Class : Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class : A.
 - 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 : A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - 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 : A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- L. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
 - 2. PVC-Coated Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Galvanized.
 - 3. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Galvanized.
 - 4. Aluminum Ducts: Aluminum.
- M. Liner:
 - 1. Exhaust Air Ducts: Fibrous glass, Type I, 1 inch thick.
 - 2. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.
- N. Double-Wall Duct Interstitial Insulation:
 - 1. Supply Air Ducts: 1 inch thick.
 - 2. Return Air Ducts: 1 inch thick.
- O. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "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) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Welded.
- P. Branch Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "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.

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SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Stationary Louvers
2. Backdraft and pressure relief dampers.
3. Barometric relief dampers.
4. Control dampers.
5. Fire dampers.
6. Ceiling dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Flange connectors.
10. Duct silencers.
11. Turning vanes.
12. Remote damper operators.
13. Duct-mounted access doors.
14. Flexible connectors.
15. Flexible ducts.
16. Duct accessory hardware.

- B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. LEED Submittal:
 - 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
- C. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.
- D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 PRODUCTS

2.1 MATERIALS

- A. 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.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. 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.

2.2 STATIONARY LOUVERS

- A. Refer to Architectural Drawings for louver requirements.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Duro Dyne Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Lloyd Industries, Inc.
 - 7. Nailor Industries Inc.
 - 8. NCA Manufacturing, Inc.
 - 9. Pottorff; a division of PCI Industries, Inc.

10. Ruskin Company.
11. SEMCO Incorporated.
12. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 1-inch wg.
- E. Frame: 0.063-inch thick extruded aluminum, with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum 0.050-inch-thick aluminum sheet noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked].
- I. Blade Axles:
 1. Material: Galvanized steel.
 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball.
- M. Accessories:
 1. Adjustment device to permit setting for varying differential static pressure.
 2. Counterweights and spring-assist kits for vertical airflow installations.
 3. Electric actuators.
 4. Chain pulls.
 5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20-gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 6. Screen Material: Galvanized steel
 7. Screen Type: Bird
 8. 90-degree stops.

2.4 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, Work include, but are not limited to, the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Duro Dyne Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Lloyd Industries, Inc.
 - 7. Nailor Industries Inc.
 - 8. NCA Manufacturing, Inc.
 - 9. Pottorff; a division of PCI Industries, Inc.
 - 10. Ruskin Company.
 - 11. SEMCO Incorporated.
 - 12. Vent Products Company, Inc.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: 0.064-inch- thick, galvanized sheet steel, with welded corners and mounting flange.
- F. Blades:
 - 1. Multiple, 0.025-inch-thick, roll-formed aluminum.
 - 2. Maximum Width: 6 inches.
 - 3. Action: Parallel.
 - 4. Balance: Gravity.
 - 5. Eccentrically pivoted.
- G. Blade Seals: Neoprene.
- H. Blade Axles: Galvanized steel.

- I. Tie Bars and Brackets:
 - 1. Material: Galvanized steel.
 - 2. Rattle free with 90-degree stop.
- J. Return Spring: Adjustable tension.
- K. Bearings: Stainless steel.
- L. Accessories:
 - 1. Flange on intake.
 - 2. Adjustment device to permit setting for varying differential static pressures.

2.5 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Galvanized steel.
- B. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
 2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Hat shaped.

- b. Galvanized -steel channels, 0.064 inch thick.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized, roll-formed steel, 0.064 inch thick.
 - 6. Blade Axles: Stainless steel
 - 7. Bearings:
 - a. Oil-impregnated bronze
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Blade Seals: Neoprene.
 - 9. Jamb Seals: Cambered stainless steel].
 - 10. Tie Bars and Brackets: Galvanized steel.
 - 11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- C. Low-Leakage, Aluminum, Manual Volume Dampers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.

- h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
 - 2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames: Hat shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - 6. Blade Axles: Stainless steel
 - 7. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Blade Seals: Neoprene.
 - 9. Jamb Seals: Cambered aluminum.
 - 10. Tie Bars and Brackets: Aluminum.
 - 11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- D. Jackshaft:
 - 1. Size: 1-inch diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

E. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.6 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. Lloyd Industries, Inc.
8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
9. McGill AirFlow LLC.
10. METALAIRE, Inc.
11. Metal Form Manufacturing, Inc.
12. Nailor Industries Inc.
13. NCA Manufacturing, Inc.
14. Ruskin Company.
15. Vent Products Company, Inc.
16. Young Regulator Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat shaped.
2. Galvanized steel channels, 0.064 inch thick.

3. Mitered and welded corners.
- D. Blades:
1. Multiple blade with maximum blade width of 8 inches .
 2. Opposed-blade design.
 3. Galvanized Stainless steel.
 4. 0.064 inch thick.
 5. Blade Edging: Closed-cell neoprene edging.
- E. Blade Axles: 1/2-inch-diameter; stainless steel]; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
1. Oil-impregnated bronze.
 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 3. Thrust bearings at each end of every blade.

2.7 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
 2. Arrow United Industries; a division of Mestek, Inc.
 3. Cesco Products; a division of Mestek, Inc.
 4. Greenheck Fan Corporation.
 5. McGill AirFlow LLC.
 6. METALAIR, Inc.
 7. Nailor Industries Inc.
 8. NCA Manufacturing, Inc.
 9. PHL, Inc.
 10. Pottorff; a division of PCI Industries, Inc.
 11. Prefco; Perfect Air Control, Inc.

12. Ruskin Company.
 13. Vent Products Company, Inc.
 14. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Type: Static rated and labeled according to UL 555 by an NRTL.
- C. Fire Rating: 1-1/2 and 3 hours. Coordinate with Architectural Floor Plans for location of building separation ratings.
- D. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- I. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.8 CEILING DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. McGill AirFlow LLC.
 4. METALAIRE, Inc.
 5. Nailor Industries Inc.
 6. Prefco; Perfect Air Control, Inc.
 7. Ruskin Company.
 8. Vent Products Company, Inc.
 9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. General Requirements:
 - 1. Labeled according to UL 555C by an NRTL.
 - 2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.
- D. Blades: Galvanized sheet steel with refractory insulation.
- E. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- F. Fire Rating: 2 and 3 hours. Coordinate with Architectural Floor Plans for location of building separation ratings.

2.9 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. PHL, Inc.
 - 6. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- F. Leakage: Class I
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.
- I. Damper Motors: Spring return two-position action as manufactured by Belimo – FS Series.

- J. 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."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26.
 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F
 6. Electrical Connection: 24VAC or as otherwise coordinated between the Mechanical Contractor and Electrical Contractor/Fire Alarm System.
- K. Accessories:
1. Auxiliary switches for position indication.
 2. Momentary test switch mounted on ceiling directly below damper assembly.

2.10 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Greenheck Fan Corporation.
 4. Nailor Industries Inc.
 5. Ruskin Company.
- B. Type: Static; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Fire Rating: 1-1/2 and 3 hours.
- D. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- E. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

- F. Smoke Detector: Integral, factory wired for single-point connection.
- G. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- H. Blades: Roll-formed, horizontal, interlocking, 0.034-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized-steel blade connectors.
- I. Leakage: Class I.
- J. Rated pressure and velocity to exceed design airflow conditions.
- K. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- L. Master control panel for use in dynamic smoke-management systems.
- M. Damper Motors: Spring return two-position action as manufactured by Belimo – FS Series.
- N. 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."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Electrical Connection: 24VAC or as otherwise coordinated between the Mechanical Contractor and Electrical Contractor/Fire Alarm System.
- O. Accessories:
 - 1. Auxiliary switches for position indication.
 - 2. Momentary test switch mounted on ceiling directly below damper assembly.

2.11 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.12 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.
- F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.13 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Ductmate Industries, Inc.
 4. Flexmaster U.S.A., Inc.
 5. Greenheck Fan Corporation.
 6. McGill AirFlow LLC.
 7. Nailor Industries Inc.
 8. Pottorff; a division of PCI Industries, Inc.
 9. Ventfabrics, Inc.
 10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - e. Access Doors Larger Than 24 by 48 Inches Four hinges and two compression latches with outside and inside handles.

2.14 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Flame Gard, Inc.
 - 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon or 0.0428-inch stainless steel. Access Panel Material shall match duct material.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.15 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.

- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outdoor 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.
 - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.16 FLEXIBLE DUCT

- A. Air Device Connection Ductwork: Flexible fiberglass duct with a maximum thermal conductivity of 0.29 BTU/HR - degrees F - Sq.Ft. at 75 degrees F mean temperature with a maximum flame spread rating of 25 and smoke developed rating of 50. Flexible fiberglass duct shall be Owens-Corning Pink AF-FDM minimum R-6 insulation or approved equal. The duct shall conform to NFPA 90A, 90B, and be listed by Underwriters Laboratories as 181 Class I Air Duct.
 - 1. Branch Connections shall be made to main ducts with metal ductwork or flexible fiberglass ductwork as indicated on the drawings and as dictated by the length of the branch duct run. Refer to minimum and maximum flexible duct length and drawing details, balance of branch shall be made in metal duct. All Branches to air device connections shall be provided with a Bellmouth Take-Off connector fitting with damper including gasket, indexed locking quadrant handle, elevated standoff bracket (nominal 2"), nylon closed end bearings, 3/8" square bar shaft, U-bolts as manufactured by Buckley Associates, Inc. Air-Tite Model BMD-B01 or Flexmaster Model CBD-B03; and clamp.

45 degree Take-Off branch connector fittings with damper may be used in lieu of bellmouth takeoff fittings, where height of connector exceeds the height of the main duct dimension. 45 degree Take-Off branch connector fittings with damper shall include gasket, indexed locking quadrant handle, elevated standoff bracket (nominal 2"), nylon closed end bearings, 3/8" square bar shaft, U-bolts as manufactured by Buckley Associates, Inc. Air-Tite Model 3300D-B01 or Flexmaster Model STOD-B03.

2. Flexible fiberglass duct size shall be same as air device neck size unless otherwise noted.
 3. Flexible fiberglass duct length shall be a maximum of 9 feet and a minimum of 6 feet. Support final 90 degree elbow directly over ceiling air-devices (supply and return) with Titus FlexRight nylon strap. Refer to detail on drawings.
- B. Flexible Duct Connectors:
1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

2.17 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Louver Installation:
1. Inspect areas to receive louvers. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the louvers. Do not proceed with installation until unsatisfactory conditions are corrected.
 2. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.
 3. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
 4. Install joint sealants as specified in Section 07920.
 5. Clean louver surfaces in accordance with manufacturer's instructions.
 6. Repair minor damaged surfaces as directed by Architect.
- B. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- C. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- D. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts, and located as far from the air outlet or inlet devices as possible while remaining accessible for balancing. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated.
- H. Install fire and smoke dampers according to UL listing.
- I. Connect ducts to duct silencers rigidly.
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from fire alarm duct detectors at air-handler supply and return ductwork.
 - 3. Upstream and downstream from fire duct mounted air-monitors return ductwork .
 - 4. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 5. Upstream or downstream from duct silencers.
 - 6. Control devices requiring inspection.
 - 7. Elsewhere as indicated.
- K. Install access doors with swing against duct static pressure.
- L. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.

- M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- N. Install flexible connectors to connect ducts to equipment.
- O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Connect terminal units to supply ducts with maximum 48 inch lengths of flexible duct. Do not use flexible ducts to change directions.
- Q. Connect flexible ducts to metal ducts with draw bands.
- R. Install duct test holes where required for testing and balancing purposes.
- S. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

*** END OF SECTION 23 33 00 ***

SECTION 23 34 23 - HVAC POWER VENTILATORS

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. Centrifugal roof ventilators.
 - 2. Axial roof ventilators.
 - 3. Upblast propeller roof exhaust fans.
 - 4. Centrifugal wall ventilators.
 - 5. Ceiling-mounting ventilators.
 - 6. In-line centrifugal fans.
 - 7. Propeller fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.
- C. High Wind/Hurricane Construction
 - 1. All roof top equipment shall bare the Miami Dade Notice of Acceptance Label.
 - 2. Each piece of rooftop equipment covered in this section shall bare the Miami Dade Notice of Acceptance (N.O.A.) seal and be listed by Miami-Dade as having passed each of the following tests. The passage of fewer test standards will not be accepted.
 - a. TAS-201: Large and Small Missile Impact Test
 - b. TAS-202: Uniform Structural Load Test
 - c. TAS-203: Uniform Cyclic Pressure Test
 - 3. Tests shall be based on a minimum 150 mile per hour wind standard.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
- 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. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- C. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.
- E. Provide non-fading engraved nameplate data riveted to equipment.
- F. Submittal information shall include specific and detailed information as provided by the manufacturer clearly showing the proper method of installation for each piece of equipment to be furnished for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: two set(s) for each belt-driven unit.

1.9 WARRANTY

- A. Provide five year manufacturer's warranty under provisions of Division 1.

PART 2 PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Greenheck.
 - 2. Loren Cook Company.
 - 3. Penn Ventilation.
- B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
 - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.

2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust airstream.
- F. Accessories:
 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
- G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 1. Configuration: Coordinate flashing cant strip and slope of curb with actual roof conditions. Refer to Architectural plans for slope requirements.
 2. Overall Height Above the Roof Level: 12 inches minimum.
 3. Pitch Mounting: Manufacture curb for roof slope.
 4. Metal Liner: Galvanized steel.

2.2 AXIAL ROOF VENTILATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Bayley Fans; a division of Lau Industries, Inc.
 2. Greenheck.
 3. Loren Cook Company.
- B. Description: Direct- or belt-driven axial fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

- C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged, aluminum base.
 - 1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- D. Fan Wheel: Aluminum hub and blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
- F. Accessories:
 - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
 - 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

2.3 CENTRIFUGAL WALL VENTILATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Greenheck.
 - 2. Loren Cook Company.
 - 3. Penn Ventilation.
- B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.
- D. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.

4. Fan and motor isolated from exhaust airstream.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Wall Grille: Ring type for flush mounting.
5. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.

2.4 CEILING-MOUNTING VENTILATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Broan Mfg. Co., Inc.
 2. Greenheck.
 3. Loren Cook Company.
 4. NuTone Inc.
 5. Penn Ventilation.
- B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- C. Housing: Steel, lined with acoustical insulation.
- D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- E. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- G. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
 3. Isolation: Rubber-in-shear vibration isolators.

4. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.5 IN-LINE CENTRIFUGAL FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Greenheck.
 2. Loren Cook Company.
 3. Penn Ventilation.
- B. Description: In-line, direct and belt-driven (refer to fan schedule on drawings) centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.
- E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- G. Accessories:
 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
 3. Companion Flanges: For inlet and outlet duct connections.
 4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
 5. Vibration Isolators:
 - a. Type: Elastomeric hangers.
 - b. Static Deflection: 1 inch
 6. Spark Arrestance Class: B unless otherwise noted on the fan schedule.

2.6 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.7 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Support units using elastomeric mounts or spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Secure roof-mounting fans to roof curbs with cadmium-plated hardware and G-90 galvanized hurricane straps not less than 1 inch wide 20 gauge or as required by Miami-Dade installations mounting requirements whichever is more stringent. See manufacturer's instructions for each specific piece of equipment and follow requirements as listed. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- F. Support suspended units from structure using threaded steel rods and elastomeric hangers or spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- G. Install units with clearances for service and maintenance.
- H. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.

- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

*** END OF SECTION 23 34 23 ***

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SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Shutoff, single-duct air terminal units.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: 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".

1.4 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.
 - 4. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of one to 4 inch W.G.
- C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- D. Field quality-control reports.

- E. 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.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, by a qualified testing agency, and marked for intended location and application.
- B. Units shall be UL Listed.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

1.7 WARRANTY

- A. Provide manufacturer's warranty under provisions of Division 1.
- B. Warranty period shall commence at completion of final substantial completion.

PART 2 PRODUCTS

2.1 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide TRANE or comparable product by one of the following:
 - 1. METALAIR, Inc.
 - 2. Titus.
 - 3. Other Substitutes—Submit a written substitution request, prior to bid, to the Architect/Engineer in accordance with Basic Mechanical Requirements. Accepted substitutes will be notified via Addendum.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud. Unit shall have single point connection. Air flow unit shall be provided with an inspection plate to allow for inspection of damper movement. Air flow units shall be installed such that the inspection plate can be easily accessible for removal. Inspection plate shall be internally insulated in a manner similar to the rest of the unit.

- C. Casing: 0.034-inch (22 gauge) zinc-coated steel, single wall.
 - 1. Casing Lining: Adhesive attached, 1-inch-thick, coated, fibrous-glass duct liner complying with ASTM C1071, 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 E84.
 - a. Cover liner with nonporous foil.
 - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 - 3. Air Outlet: S-slip and drive connections, size matching inlet size.
 - 4. Access: Removable panels for access to 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. Volume Damper: Air volume damper assemblies shall be made from extruded aluminum components. Damper blades shall have extruded ribs which key into grooved shaft for permanent fix of damper. All internal damper pivot points shall be nylon fitted for noiseless operation requiring no lubrication.
 - 1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 1-inch wg inlet static pressure.
- E. Electric-Resistance Heating Coils (UL recognized): Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in plated-steel, machine-staked terminals secured with plated-steel hardware.
 - 1. Access door interlocked fused disconnect switch.
 - 2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.) Refer to drawings for quantity.
 - 3. Nickel chrome 80/20 heating elements.
 - 4. Airflow switch for proof of airflow.
 - 5. Fan interlock contacts.
 - 6. Fuses in terminal box for overcurrent protection (for coils more than 48A).
 - 7. Mercury contactors when PWM control is scheduled on drawings.
 - 8. Electric heating coil panel enclosure shall be a single point power connection and shall include a stepdown transformer capable of providing 24 VAC power to the DDC control panel.

- F. Direct Digital Controls: Single-package unitary controller and actuator specified on the Controls Drawings and in Division 23 Section "Instrumentation and Control for HVAC." All control elements that will be mounted on or which shall control the air flow unit shall be shipped to the air flow unit manufacturer for assembly and testing at the air flow unit manufacturer's factory. The cost of installing and testing the air flow unit as an operational subsystem shall be borne by the air flow unit manufacturer and such manufacturer shall warrant, in writing, the air flow unit has been tested if requested by the PA/E. Any field assembly of such devices is to be pre-approved in writing prior to bid opening.
 - 1. VAVs scheduled as "cooling only" shall not include integral control transformer. Contractor shall provide central transformers for each zone, located in a nearby mechanical room, and provide low voltage cabling distributed to each cooling only VAV box in that zone. Conceal cabling above the ceiling routed on j-hooks, etc.

2.2 HANGERS AND SUPPORTS

- A. Hangers and supports per Division 23 "Hangers and Supports for HVAC Piping and Equipment."

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
 - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

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.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "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. 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. Do not support from ductwork.

3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to Division 23 Section "Ductwork."

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. All control elements that will be mounted on or which shall control the air flow unit shall be shipped to the air flow unit manufacturer for assembly and testing at the air flow unit manufacturer's factory. The cost of installing and testing the air flow unit as an operational subsystem shall be borne by the air flow unit manufacturer and such manufacturer shall warrant, in writing, the air flow unit has been tested if requested by the PA/E. Any field assembly of such devices is to be pre-approved in writing prior to bid opening.

*** END OF SECTION 23 36 00 ***

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SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

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. Registers/Grilles.
 - 2. 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 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.
 - 3. Submit engineering data in a manner to facilitate convenient review of aspiration ability, including temperature and velocity traverses, throw and drop, noise criteria ratings sizes, free area and quality of construction. Outlets shall be selected for maximum noise criteria level as scheduled on drawings.

- B. Source quality-control reports.

PART 2 PRODUCTS

2.1 CEILING DIFFUSERS, REGISTERS AND GRILLES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide TITUS or comparable product by one of the following:

- 1. METALAIRE, Inc.

2. Price Industries.
 3. Other Substitutes—Submit a written substitution request, prior to bid, to the Architect/Engineer in accordance with Basic Mechanical Requirements. Accepted substitutes will be notified via Addendum.
- B. Material: Aluminum.
 - C. Finish: Baked enamel, white.
 - D. Mounting: Duct connection.
 - E. Dampers: Radial opposed blade, adjustable from diffusers and register face.
 - F. Coordinate frame type with latest Architectural reflected ceiling plan.
 - G. Refer to schedule on drawings for type and model number.

2.2 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.
- D. Provide balancing dampers in diffusers and registers.
- E. Paint ductwork visible behind air outlets and inlets matte black.

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 23 37 13 ***

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SECTION 23 37 23 - HVAC GRAVITY VENTILATORS

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 types of roof-mounting intake and relief ventilators:
 - 1. Louver penthouses.
 - 2. Roof hoods.
 - 3. Goosenecks.
- B. Related Sections include the following:
 - 1. Division 08 Section "Louvers and Vents" for ventilator assemblies provided as part of the general construction.
 - 2. Division 23 Section "HVAC Power Ventilators" for roof-mounting exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

- A. All roof top equipment shall bare the Miami Dade Notice of Acceptance Label.
- B. Each piece of rooftop equipment covered in this section shall bare the Miami Dade Notice of Acceptance (N.O.A.) seal and be listed by Miami-Dade as having passed each of the following tests. The passage of fewer test standards will not be accepted.
 - 1. TAS-201: Large and Small Missile Impact Test
 - 2. TAS-202: Uniform Structural Load Test
 - 3. TAS-203: Uniform Cyclic Pressure Test
- C. Water Entrainment: Limit water penetration through unit to comply with AMCA 550.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. LEED Submittal (if required):
 - 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."

- C. Shop Drawings: For intake and relief ventilators. Include plans, elevations, sections, details, and ventilator attachments to curbs and curb attachments to roof structure.
- D. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members to which roof curbs and ventilators will be attached.
 - 2. Sizes and locations of roof openings.
- E. Samples for Verification: For each type of exposed finish required for intake and relief ventilators.
- F. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain ventilators through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of intake and relief ventilators and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.6 COORDINATION

- A. Coordinate installation of roof curbs and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 4 finish.
- E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 - 1. Use types and sizes to suit unit installation conditions.
 - 2. Use hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.
- F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

- A. Factory or shop fabricate intake and relief ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

2.4 ROOF HOODS

- A. Manufacturers:
 - 1. Greenheck.
 - 2. Loren Cook Company.
 - 3. Penn Ventilation.
- B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.

- C. Materials: Aluminum sheet, minimum 0.063-inch thick base and 0.050-inch thick hood; suitably reinforced.
- D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
 - 1. Configuration: Coordinate flashing cant strip and slope of curb with actual roof conditions. Refer to Architectural plans for slope requirements.
 - 2. Overall Height Above the Roof Level: 12 inches minimum.
 - 3. Pitch Mounting: Manufacture curb for roof slope.
 - 4. Metal Liner: Galvanized steel.
- E. Bird Screening: Galvanized-steel, 1/2-inch-square mesh.
- F. Galvanized-Steel Sheet Finish:
 - 1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.

2.5 GOOSENECKS

- A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 5-5; with a minimum of 0.052-inch-thick, galvanized-steel sheet.
- B. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
 - 1. Configuration: Coordinate flashing cant strip and slope of curb with actual roof conditions. Refer to Architectural plans for slope requirements.
 - 2. Overall Height Above the Roof Level: 12 inches minimum.
 - 3. Pitch Mounting: Manufacture curb for roof slope.
 - 4. Metal Liner: Galvanized steel.
- C. Bird Screening: Galvanized-steel, 1/2-inch-square mesh.
- D. Galvanized-Steel Sheet Finish:
 - 1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.

2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install intake and relief ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Secure intake and relief ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.]
- C. Install goosenecks on curb base where throat size exceeds 6 by 6 inches.
- D. Install intake and relief ventilators with clearances for service and maintenance.
- E. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.
- G. Label intake and relief ventilators according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- H. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- I. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

*** END OF SECTION 23 37 23 ***

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SECTION 23 38 13 - KITCHEN CANOPY AND DUCT FIRE PROTECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Wet Chemical Fire Protection System.

1.2 REFERENCES

- A. ANSI/ASME A13.1—Scheme for the Identification of Piping Systems.
- B. NFPA 96 and 17.

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 23 05 00 and Division 1.
- B. Submit manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS—KITCHEN HOOD/FIRE PROTECTION

- A. Furnish and install a complete and operable, pre-engineered, UL listed, wet chemical fire suppression system including, but not limited to, fire protection of cooking equipment, exhaust hood, grease removal device, and exhaust duct as per NFPA 96 and 17A.
- B. All materials shall be UL listed, new and free of defects as per NFPA.
- C. Each wet chemical storage tank shall be D.O.T. rated for stored pressure of 175 psi and shall be provided with a pressure gauge.
- D. The system shall be capable of automatic or manual activation.
- E. Piping and fittings shall be schedule 40 (standard weight) steel or stainless steel.
- F. Wet chemical cylinders.
- G. Remote manual pull station.
- H. Bell/horns.
- I. Fusible links.
- J. Nozzles.
- K. Automatic gas valve shut-off.
- L. Cylinder control head.

- M. System shall be ANSUL or approved equal.
- N. Hood temperature sensor and interlock with hood supply/exhaust fans. Fans shall automatically start within 15 minutes of the appliance under the hood being turned ON, in accordance with Florida Building Code-Mechanical.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All pipe and fittings shall be reamed and blown clear of chips and scale. Threading compound shall be used sparingly and only on male threads.
- B. All piping shall be securely supported.
- C. Each manual pull station shall be located in the path of egress from the kitchen. The manual pull station shall be mounted at 4'-6" above finished floor.
- D. Alarm bell shall be located within the kitchen area so that it may be heard throughout the area.
- E. UL electric solenoid gas valves or UL mechanical gas valves, where applicable, shall be furnished and installed by the Fire Protection Contractor. The Fire Protection Contractor shall be responsible for providing power, wiring, conduit, etc. to all device locations.
- F. Electrical contactors shall be provided by the Fire Protection Contractor. The Fire Protection Contractor shall be responsible for installing the contactors and providing power, wiring, conduit, etc., to all locations.
- G. The Fire Protection Contractor shall provide all accessory equipment such as micro switches and relays for automatic shutdown of kitchen equipment, supply fans, fuel and heat sources, etc. Each canopy exhaust fan shall continue to run.
- H. The extinguishing system shall be installed and tested in accordance with NFPA-17A, NFPA-96, national electrical codes latest editions and the Manufacturer's recommendations.

3.2 SYSTEM GUARANTEE

- A. All components, parts, and assemblies supplied by the Manufacturer shall be guaranteed against defects in materials and workmanship for a period of one (1) year commencing upon start up and beneficial use. Warranty services shall be provided by a qualified factory trained representative of the Equipment Manufacturer during normal working hours, Monday through Friday, excluding holidays. The representative shall be based in a fully staffed branch office located within a reasonable distance from the job site with an adequate supply of repair parts. Manufacturer's statement of warranty shall be included in the submittals. This Contractor shall also demonstrate the system operation to the Owner/Engineer.

*** END OF SECTION 23 38 13 ***

SECTION 23 63 13 - AIR-COOLED REFRIGERANT CONDENSERS

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 packaged, air-cooled condensers for outdoor installation.

1.3 SUBMITTALS

- A. Product Data: For each air-cooled condenser, include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, wiring diagram, electrical nameplate data, and location and size of each field connection.
- B. Design Data: Submit under provisions of Basic Mechanical Requirements and Division 1. Indicate pipe and equipment sizing.
- C. Submit manufacturer's installation instructions.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For air-cooled condensers to include in emergency, operation, and maintenance manuals.
- F. LEED Submittal:
 - 1. Product Data for Credit EA4: Documentation required by Credit EA4 indicating that equipment and refrigerants comply.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operations and maintenance data.
- B. Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air-cooled condensers and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- 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. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- D. ASHRAE/IESNA90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."
- C. Coordinate location of refrigerant piping and electrical rough-ins.

1.7 DELIVERY, STORAGE AND HANDLING

- A. As part of the requirements, the Manufacturer of equipment herein specified shall deliver to the job site, ready for installation within twelve (12) weeks of receiving the purchase order.
- B. Deliver, store, and protect products under provisions of Division 1.
- C. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- D. Protect units on site from physical damage. Protect coils.

1.8 WARRANTY

- A. The refrigeration equipment manufacturer's warranty shall cover material and workmanship that prove defective for a period of one year from date of equipment start up but not more than 18 months from date of shipment, including refrigerant.
- B. EXTENDED WARRANTY: Provide an extended warranty to extend upon completion of year one through year five. The warranty shall cover materials that prove defective within the extended period, including refrigerant.
- C. Compressors shall carry a 5 year warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis of Design—Trane
 - 2. Daikin.
 - 3. Carrier.

4. Other Substitutes—Submit a written substitution request, prior to bid, to the Architect/Engineer in accordance with Basic Mechanical Requirements. Accepted substitutes will be notified via Addendum.

2.2 MANUFACTURED UNITS

- A. Description: Factory assembled and tested; consisting of casing, condenser coils, condenser fans and motors, and unit controls.
- B. Condenser Coil: Seamless copper-tube, finned coil; factory tested at 425 psig.
 1. Coil Fin: Aluminum
 2. Coil Coating: Refer to Equipment Schedule
 3. Circuit: To match compressors with liquid subcooling coil.
 4. Refrigerant Accessories: Provide receiver, pressure control, and solenoid valve for each circuit.
- C. Condenser Fans and Drives: Propeller fans with aluminum or galvanized-steel fan blades, for vertical air discharge; directly driven with permanently lubricated ballbearing motors with integral current- and thermal-overload protection.
- D. Operating and Safety Controls: Include condenser fan motor thermal and overload cutouts; 115-V control transformer, if required; magnetic contactors for condenser fan motors and a nonfused factory-mounted and -wired disconnect switch for single external electrical power connection.
- E. Unit Casings: Galvanized or zinc-coated steel treated and finished with manufacturer's standard paint coating, designed for outdoor installation with weather protection for components and controls, and with the following:
 1. Removable panels for access to controls, condenser fans, motors, and drives.
 2. Plated-steel fan guards.
 3. Lifting eyes.
 4. Removable legs.
 5. Coil Guard: PVC coated steel wire.

2.3 COMPRESSORS

- A. Construction: Serviceable hermetic or semi-hermetic reciprocating type with external spring insulators, heat treated forged steel or cast iron shafts, aluminum alloy connecting rods, automotive type pistons, rings to prevent gas leakage, suction and discharge valves, and sealing surface immersed in oil.
- B. Mounting: Statically and dynamically balance rotating parts and mount on rubber-in-shear vibration isolators.
- C. Motor: Constant speed 3600 rpm suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting.

- D. Crankcase Heater: Evaporates refrigerant returning to crankcase during shut down. Energize heater thermostatically.

2.4 MOTORS

- A. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2.5 REFRIGERANT CIRCUIT

- A. Provide each unit with single independent refrigerant circuits, factory supplied and piped.
- B. Provide the following for each refrigerant circuit:
 - 1. Filter dryer replaceable core type.
 - 2. Liquid line sight glass and moisture indicator.
 - 3. Thermal expansion valve for maximum operating pressure.
 - 4. Insulated suction line.
 - 5. Suction and liquid line service valves, and gage ports.
 - 6. Liquid line solenoid valve.
 - 7. Charging valve.
 - 8. Discharge line check valve.
 - 9. Compressor discharge service valve.
 - 10. Condenser pressure relief valve.
 - 11. Refer to Piping Detail on Drawings.
 - 12. Refrigerant specialties can be field supplied and piped, as required. Installing Contractor shall coordinate piping requirements with Manufacturer.

2.6 CONTROLS

- A. Controls: Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Control wiring shall be 24-volt control circuit which includes fusing and control transformer. Units shall provide external location for mounting a fused disconnect device. Time delay timers to prevent compressors in dual compressor units from simultaneous start-up and anti-recycle timers are available as optional accessories.

- B. Defrost Controls: Electronic timed initiated, temperature terminated defrost system with choice of 50, 70, or 90 minute cycle. Timed override limits defrost cycle to 10 minutes.
- C. Low Ambient Operation: Standard units shall start and operate to approximately 35°F when matched with Trane air handlers and coils. Optional head pressure control accessory permits operation to 0°F.
- D. Anti-Short Cycle Timer: Shall prevent rapid on-off compressor cycling in light load conditions by not allowing compressor to operate for 5-7 minutes upon shutdown. Shall consist of a solid state timing device, 24-volt, 60 cycle with either 5 or 7 minute fixed-off timing period.

2.7 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate air-cooled condensers according to ARI 460.
- B. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of air-cooled condensers.
- B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.
- C. Examine walls, floors, and roofs for suitable conditions where air-cooled condensers will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- B. Install air-cooled condensers on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.
- C. Install roof-mounting units on equipment supports specified in Division 07.
- D. Vibration Isolation: Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Support suspended units from structure using threaded steel rods.
- F. Maintain manufacturer's recommended clearances for service and maintenance.
- G. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Refrigerant Piping: Connect piping to unit with pressure relief, service valve, filter-dryer, and moisture indicator on each refrigerant-circuit liquid line. Refrigerant piping and specialties are specified in Division 23 Section "Refrigerant Piping."

3.4 FIELD QUALITY CONTROL

- A. Contractor shall engage a factory-authorized, Manufacturer representative to review the manufacturer's equipment and piping installation requirements prior to commencing work.
- B. The Manufacturer representative shall perform a minimum of two site visits to review the hydronic piping installation with the Contractor. The first site visit shall occur prior to the Contractor commencing work to review manufacturer installation requirements. The second site visit shall occur after the refrigerant piping installation is substantially complete, or when requested by the Manufacturer. Contractor shall accommodate additional manufacturer site visits as required.
- C. Contractor shall submit Manufacturer pre-pipe/post-pipe installation reports to the Owner/Engineer. Contractor shall correct any identified deficiencies at no expense to the project.
- D. Perform the following field tests and inspections:
 - 1. Perform electrical test and visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system 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. Complete manufacturer's starting checklist.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Verify proper airflow over coils.
- E. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- F. Remove and replace malfunctioning air-cooled condensers and retest as specified above.

3.5 STARTUP SERVICE

- A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Inspect for physical damage to unit casing.
 - 2. Verify that access doors move freely and are weathertight.

3. Clean units and inspect for construction debris.
 4. Verify that all bolts and screws are tight.
 5. Adjust vibration isolation and flexible connections.
 6. Verify that controls are connected and operational.
- B. Lubricate bearings on fans.
- C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
- D. Contractor shall notify manufacturer when equipment is ready for start-up. Manufacturer shall start unit and complete startup checklist.
- E. Measure and record airflow over coils.
- F. Verify proper operation of capacity control device.
- G. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- H. Contractor shall correct any identified deficiencies until manufacturer start-up is complete.
- I. After startup and performance test, lubricate bearings.
- J. Provide initial and cooling season start-up, and winter season shut down during first year of operation, including routine servicing and check out.
- K. Provide initial charge of refrigerant and oil for each refrigerant circuit. Replace losses of refrigerant and oil.
- L. Inspect and test for refrigerant leaks every 3 months during first year of operation, and repair leaks.

*** END OF SECTION 23 63 13 ***

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SECTION 23 64 23 - AIR-COOLED SCROLL WATER CHILLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Chiller Package.
- B. Charge of Refrigerant and Oil.
- C. Controls and Control Connections.
- D. Chilled Water Connections.
- E. Starters.
- F. Electrical Power Connections.

1.2 REFERENCES

- A. ANSI/ASHRAE 15—Safety Code for Mechanical Refrigeration.
- B. ANSI/ASHRAE 90A—Energy Conservation in New Building Design.
- C. ANSI/ASME SEC 8—Boiler and Pressure Vessel Code.
- D. ANSI/NEMA MG 1—Motors and Generators.
- E. ARI 590.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 23 05 00 and Division 1.
- B. Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate valves, strainers, and thermostatic valves required for complete system.
- C. Submit product data under provisions of Division 1.
- D. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements, wiring diagrams, and part load curves.
- E. Submit written certification that components of package not furnished by manufacturer have been selected in accordance with manufacturers requirements.
- F. Submit manufacturer's installation instructions under provisions of Division 1.
- G. The Manufacturer shall review the contract drawings for space requirements, and state any modifications required for clearances, piping, electrical, and controls.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operations data under provisions of Division 1.
- B. Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include troubleshooting guide.
- C. Submit maintenance data under provisions of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 1. The Manufacturer's Technicians are to assemble the components that are shipped loose.
- B. The Contractor is to store, protect, and install products under provisions of Division 1.
- C. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- D. The Contractor is to protect units on site from physical damage.

1.6 WARRANTY

- A. Provide five (5) year warranty on the motor compressor assembly along with a one (1) year warranty on parts and labor for the entire machine.
- B. The Manufacturer shall be responsible for the chiller installation to conform to recommended requirements for operating accessibility and maintenance. The Manufacturer shall also provide an authorized factory representative for initial start-up of the machine.

1.7 MAINTENANCE SERVICE

- A. The Manufacturer shall provide two (2) operating inspections the first year and one (1) shutdown inspection **at the end of the first year**.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis of Design—Trane (Pre-bid Submittal Required).
- B. Pre-approved Substitutes (Approved to Bid).
 - 1. Daikin (Pre-bid Submittal Required).
 - 2. Carrier (Pre-bid Submittal Required).
- C. Other Substitutes—Submit a written substitution request, prior to bid, to the Architect/Engineer in accordance with Specification Section 23 05 00. Accepted substitutes will be notified via Addendum.

2.2 MANUFACTURED UNITS

- A. Provide factory assembled, factory tested, single piece, multi-compressor, air-cooled rotary liquid chiller complete with starter. Contained within the unit cabinet shall be all factory wiring, piping, controls, refrigerant charge, 115 volt convenience outlet, and special features required prior to field start-up.
- B. Unit shall have completely independent refrigeration circuits with one compressor per circuit.
- C. Cabinet:
 - 1. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
 - 2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
 - 3. Casing: Galvanized steel.
 - 4. Finish: Refer to Paragraph 2.3.
 - 5. Sound-reduction package consisting of the following:
 - a. Acoustic enclosure around compressors.
 - b. Reduced-speed fans with acoustic treatment designed to reduce sound level without affecting performance.
 - 6. Security Package: Provide security grilles with fasteners for additional protection of compressors, evaporator, and condenser coils. Grilles shall be coated for corrosion resistance and shall be removable for service access.
- D. Compressors:
 - 1. Description: Positive-displacement direct drive with hermetically sealed casing.
 - 2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
 - 3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
 - 4. Capacity Control: On-off compressor cycling, plus hot-gas bypass.
 - 5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.
 - 6. Vibration Isolation: Mount individual compressors on vibration isolators.
- E. Compressor Motors:
 - 1. Hermetically sealed and cooled by refrigerant suction gas.
 - 2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

F. Compressor Motor Controllers:

1. Lead compressor: Variable speed drive
2. Additional compressors: Across the Line, NEMA ICS 2, Class A, full voltage, non-reversing.

G. Refrigeration:

1. Refrigerant: R-454b. Classified as Safety Group A2L according to ASHRAE 34.
2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

H. Evaporator:

1. Brazed-plate or shell-and-tube design, as indicated.
2. Shell and Tube:
 - a. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.
 - b. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
 - c. Shell Material: Carbon steel.
 - d. Shell Heads: Removable carbon-steel heads with multi-pass baffles designed to ensure positive oil return and located at each end of the tube bundle.
 - e. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping.
 - f. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
3. Brazed Plate:
 - a. Direct-expansion, single-pass, brazed-plate design.
 - b. Type 316 stainless-steel construction.
 - c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.

- d. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.
- 4. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F (minus 29 deg C).
- 5. Remote Mounting: Designed for remote field mounting where indicated. Provide kit for field installation.
- I. Air-Cooled Condenser:
 - 1. Plate-fin coil with integral sub-cooling on each circuit, rated at 450 psig (3103 kPa).
 - a. Construct coils of copper tubes mechanically bonded to aluminum fins.
 - b. Coat coils with a baked epoxy corrosion-resistant coating after fabrication.
 - c. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
 - 2. Fans: Low noise, variable speed, direct-drive, propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
 - 3. Fan Motors: Totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
 - 4. Fan Guards: Steel safety guards with corrosion-resistant coating.
- J. Electrical Power:
 - 1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
 - 2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
 - 3. Wiring shall be numbered and color-coded to match wiring diagram.
 - 4. Install factory wiring outside of an enclosure in a raceway.
 - 5. Field power interface shall be to NEMA KS 1, heavy-duty, non-fused disconnect switch.
 - 6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:
 - a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947- 4-1.
 - b. NEMA KS 1, heavy-duty, non-fusible switch.
 - c. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

7. Provide each motor with overcurrent protection.
 8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
 9. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
 10. Provide power factor correction capacitors to correct power factor to 0.90 at full load.
 11. Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
 - a. Power unit-mounted controls where indicated.
 12. Control Relays: Auxiliary and adjustable time-delay relays.
 13. Indicate the following for water chiller electrical power supply:
 - a. Current, phase to phase, for all three phases
 - b. Voltage, phase to phase and phase to neutral for all three phases.
 - c. Three-phase real power (kilowatts).
 - d. Three-phase reactive power (kilovolt amperes reactive).
 - e. Power factor.
 - f. Running log of total power versus time (kilowatt hours)
 - g. Fault log, with time and date of each.
- K. Controls:
1. Stand-alone, microprocessor based.
 2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
 3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:
 - a. Date and time.
 - b. Operating or alarm status.
 - c. Operating hours.
 - d. Outside-air temperature if required for chilled-water reset.
 - e. Temperature and pressure of operating set points.
 - f. Entering and leaving temperatures of chilled water.
 - g. Refrigerant pressures in evaporator and condenser.

- h. Saturation temperature in evaporator and condenser.
 - i. No cooling load condition.
 - j. Elapsed time meter (compressor run status).
 - k. Pump status.
 - l. Antirecycling timer status.
 - m. Percent of maximum motor amperage.
 - n. Current-limit set point.
 - o. Number of compressor starts.
4. Control Functions:
- a. Manual or automatic startup and shutdown time schedule.
 - b. Entering and leaving chilled-water temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on space temperature.
 - c. Current limit and demand limit.
 - d. External water chiller emergency stop.
 - e. Antirecycling timer.
 - f. Automatic lead-lag switching.
5. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:
- a. Low evaporator pressure or high condenser pressure.
 - b. Low chilled-water temperature.
 - c. Refrigerant high pressure.
 - d. High or low oil pressure.
 - e. High oil temperature.
 - f. Loss of chilled-water flow.
 - g. Control device failure.
- L. Insulation:
- 1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
 - 2. Thickness: 3/4 inch (19 mm)

3. Factory-applied insulation over cold surfaces of water chiller components.
 - a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
4. Apply protective coating to exposed surfaces of insulation.

M. Accessories:

1. Factory-furnished, chilled water differential pressure flow switch and strainer.
2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigeration circuit.
3. Factory-furnished neoprene or spring isolators for field installation.

2.3 CORROSION RESISTANT COATING

- A. Condenser coils (tubes and fins) and exposed cabinetry shall be provided with a factory applied corrosion resistant coating. Coils shall have coating applied in a dipping process. Spray coatings are not acceptable on the condenser coils.
- B. Corrosion resistant coating shall result in less than a 1% loss of rated heat transfer capacity.
- C. Corrosion resistant coating shall be resistant to materials with a PH range from 3 to 11.
- D. Corrosion resistant coating shall have a salt spray test rating of at least 2000 hours.
- E. Corrosion resistant coating shall be non-flammable.
- F. As an acceptable alternate, the condenser coil assembly and exposed cabinetry may have a Bronz-Glow corrosion coating compliant with the above parameters applied at the Bronz-Glow factory.

2.4 SOURCE QUALITY CONTROL

- A. Perform functional test of water chillers before shipping.
- B. Factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.
- C. For water chillers located outdoors, rate sound power level according to ARI 370 procedure.

PART 3 EXECUTION

3.1 WATER CHILLER INSTALLATION

- A. Install water chillers on support structure indicated.

- B. Equipment Mounting: Install water chiller on concrete bases using elastomeric pads or elastomeric mounts. Comply with requirements in Division 03 Section "Cast-in-Place Concrete" Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Minimum Deflection: 1/4 inch (6 mm).
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment. Include neoprene washer and grommet.
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.
- E. Install separate devices furnished by manufacturer and not factory installed.

3.2 CONNECTIONS

- A. Comply with requirements in Division 23 Section "Hydronic Piping" Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to chiller to allow service and maintenance.
- C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage and drain connection with valve. Make connections to water chiller with a mechanical coupling.
- D. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

3.3 FIELD QUALITY CONTROL

- A. Contractor shall engage a factory-authorized, Manufacturer representative to review the manufacturer's equipment and piping installation requirements prior to commencing work.
- B. The Manufacturer representative shall perform a minimum of two site visits to review the hydronic piping installation with the Contractor. The first site visit shall occur prior to the Contractor commencing work to review manufacturer installation requirements. The second site visit shall occur after the hydronic piping installation is substantially complete, or when requested by the Manufacturer. Contractor shall accommodate additional manufacturer site visits as required.

- C. Contractor shall submit Manufacturer pre-pipe/post-pipe installation reports to the Owner/Engineer. Contractor shall correct any identified deficiencies at no expense to the project.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
 - 2. Verify that pumps are installed and functional.
 - 3. Verify that thermometers and gages are installed.
 - 4. Operate water chiller for run-in period.
 - 5. Check bearing lubrication and oil levels.
 - 6. Verify proper motor rotation.
 - 7. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
 - 8. Verify and record performance of chilled-water flow and low-temperature interlocks.
 - 9. Verify and record performance of water chiller protection devices.
 - 10. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- D. Prepare a written startup report that records results of tests and inspections. A copy of the report shall be submitted to the engineer and a copy shall be placed in the operation and maintenance manuals for owner reference.

PART 4 PRE-BID SUBMITTAL

4.1 EQUIPMENT CHECKLIST—REFER TO CHECKLISTS

- A. Equipment checklists shall be submitted by all listed manufacturers, including the Basis of Design.
- B. Equipment checklists shall be submitted fourteen (14) days prior to the bid date. The Engineer shall have seven (7) days to review the submitted checklists. Manufacturers will be given three (3) business days to revise their equipment checklists to address the Engineer's noted deficiencies prior to bid opening.

- C. The equipment checklists shall not be complete submittals, but shall include sufficient information for the Engineer to confirm the proposed equipment meets the design criteria for this project.
- D. After reviewing the equipment checklists, an Addendum will be issued to all bidders indicating the approved list of manufacturers for this project.

END OF SECTION 23 64 23

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SECTION 23 73 13 - MODULAR INDOOR CENTRAL-STATION AIR HANDLING UNITS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Packaged Modular Air Handling Units.

1.2 REFERENCES

- A. AMCA 99—Standards Handbook.
- B. AMCA 210—Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 300—Test Code for Sound Rating Air Moving Devices.
- D. AMCA 301—Method of Publishing Sound Ratings for Air Moving Devices.
- E. ANSI/AFBMA 9—Load Ratings and Fatigue Life for Ball Bearings.
- F. ANSI/AFBMA 11—Load Ratings and Fatigue Life for Roller Bearings.
- G. ANSI/UL 900—Test Performance of Air Filter Units.
- H. ARI 410—Forced-Circulation Air-Cooling and Air-Heating Coils.
- I. ARI 430—Standard for Central-Station Air-Handling Units.
- J. ARI 435—Standard for Application of Central-Station Air-Handling Units.
- K. NFPA 90A—Installation of Air Conditioning and Ventilation Systems.
- L. SMACNA—Metal Duct Standards.

1.3 QUALITY ASSURANCE

- A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301; tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.
- C. Fabrication: Conform to AMCA 99 and ARI 430.
- D. Filter Media: ANSI/UL 900 listed, Class I, approved by local authorities.
- E. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
- F. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 23 05 00 and Division 1.
- B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
- C. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gages and finishes of materials.
- D. Provide fan curves with specified operating point clearly plotted. Fan performance curve shall not be submitted in table form.
- E. Submit sound power levels for both fan outlet and casing radiation at rated capacity.
- F. Submit product data of filter media, filter performance data, filter assembly, and filter frames.
- G. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- H. Submit manufacturer's installation instructions under provisions of Division 1.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Division 1.
- B. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 1 in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs.
- B. Store and protect products under provisions of Division 1.
- C. All indoor double wall air handlers should be stored inside. When outdoor storage is necessary, it is recommended that these guidelines be followed:
 - 1. Select a well drained area, preferably a concrete pad or blacktop surface.
 - 2. Place the units on a dry surface or raised off the ground to assure adequate air circulation beneath unit and to assure that no portion of the unit contacts standing water at any time.
 - 3. Allow proper clearance around the unit to perform periodic inspection and maintenance of the equipment while in storage.
 - 4. Keep the equipment in the original shipping container for protection and care of handling.

5. Cover the unit securely with a canvas tarp.

NOTE: Use canvas only! Do not use clear or colored plastic or plastic tarps to cover the modular climate changer. Plastic will cause condensation to form in and on the equipment. This moisture can result in corrosion damage or wet storage stains.

6. Ensure that the canvas tarp is secure.
7. Do not stack units.
8. Do not pile other material on the units.
9. Loosen belt tension on dry belts.
10. Every two weeks, rotate the fan and motor shaft thirty revolutions by hand. Check for free rotation
11. Every six months, check fan shaft bearings and grease lines. Add grease using a manual grease gun following lubrication recommendations in the periodic maintenance section.
12. Check the motor lubrications; remove and clean grease plugs, and check for the presence of moisture in the grease. If moisture is present, remove the motor and send it to an authorized repair shop for bearing inspection/replacement. If no moisture is present, refer to the motor manufacturer's lubrication recommendation for proper lubrication.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
- B. Do not allow chilled water to flow through the unit when the unit is not operating.

1.8 EXTRA STOCK

- A. Provide a minimum of two extra sets of each type of filter specified in Paragraph 2.4, Filters. The first complete set (prefilter and final filter) shall be used throughout the duration of construction from the time of initial start-up until Final Completion. At the time of Substantial Completion, the second set of filters shall be installed. At the time of the Final Completion Walk-through, provide a clean set of filters so that the project is turned over with clean filters.

1.9 WARRANTY

- A. The Manufacturer shall provide an unconditional parts and labor Manufacturer's warranty for twenty-four (24) months from shipment or eighteen (18) months from operational certification by the Owner, whichever is earliest.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS—MODULAR AIR HANDLING UNITS WITH COILS

- A. Basis of Design—Trane Performance Climate Changer (Pre-bid Submittal Required)
- B. Pre-approved Substitutes (Approved to Bid)
 - 1. Daikin—(Pre-bid Submittal Required)
 - 2. Carrier—(Pre-bid Submittal Required)
- C. Other Substitutes—Submit a written substitution request, prior to bid, to the Architect/Engineer in accordance with Specification Section 23 05 00. Accepted substitutes shall be notified via Addendum.

2.2 GENERAL

- A. The Contractor shall furnish and install the modular air handling unit(s) as shown and scheduled on the plans. The units shall be installed in strict accordance with the specifications. Unit shall be complete with fan section, heating and cooling coil section, access section, filter with pre-filter section/mixing box, and all accessories specified (refer to drawings).

2.3 CASING

- A. Unit shall be constructed of a complete frame with removable panels. Removal of side panels must not affect the structural integrity of each module. All exterior wall panels shall be made of minimum 18-gauge galvanized steel. Closed cell foam gasketing shall be applied where modules are joined.
- B. Units shall have an insulated, double wall, stainless steel, indoor air quality, positively sloping drain pan under coil section for drainage of condensate. Drain connections are to be provided on both sides of the unit. The condensate drain pan shall be stainless steel.
- C. Full sized double wall access doors with safety handles shall be provided for quick access to the interior of the unit casing. Doors attached by screws or doors not continuously gasketed are not acceptable.
- D. All panels shall be sealed with closed cell foam gasketing.
- E. Units shall be double wall constructed to prevent fiberglass erosion into the airstream and to allow cleaning of the unit interior. Two-inch, 1-1/2 pound density, foam insulation shall be sandwiched between an interior wall and the exterior wall. Unit casing panels and doors shall be provided with a minimal thermal resistance (R-value) of 13. Fan section shall be perforated for sound absorption. Coil and filter sections shall be solid. Interior wall shall be minimum 20 gauge galvanized steel. Foil faced installation is not acceptable.
- F. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels and doors.
- G. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8" w.g., whichever is less, and shall not exceed 0.0042" per inch of panel span (L/240).

- H. Casing air leakage shall not exceed 1% of design airflow at the specified casing pressure.
- I. Under 52°F supply air temperature and design conditions on the exterior of the unit of 85°F dry bulb and 75°F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart, if tested casing thermal data is not available, AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.
- J. The entire unit shall have a full perimeter 6" base rail.

2.4 FILTERS

- A. Pre-filters located in mixing box shall be disposable type and shall have 2-inch thick media contained in a rigid frame. Filters shall have a rigid supporting maze across both the entering and leaving faces of the media. Filters shall be American Air Filter Model AmAir 300X or Eco-Air C35, 25%-30% efficient based on the ASHRAE 52-76 test method with tolerances conforming to Section 7.4 of ARI Standard 850-78. The filter shall be rated at no more than .20 inches W.G. initial resistance at 300 fpm face velocity. Recommended final resistance of prefilters is 1.2 inches W.G.
- B. Final air filters shall be American Air Filter—Varicel II or Eco-Air Ecocell, medium efficiency, extended surface, self-supporting, 4" mini-pleat type. Each filter shall consist of a rigid ultra-fine glass fiber media pack, securely bonded to a double wall enclosing frame.

Filter media shall be ultra-fine fiberglass formed into a thin paper-like mat with a water repellent binder. Construction shall consist of coarser fibers on the air entering side and finer fibers on the air leaving side. The rigid media pack shall consist of media pleats, structurally bonded one to the other. The finished filter shall not exceed 3-3/4" depth in direction of airflow.

The filter shall have an average atmospheric dust spot efficiency of 60-65% as determined by the ASHRAE 52-76 test method. The filter shall be rated at no more than 0.40 inches W.G. initial resistance at 500 fpm face velocity. Recommended final resistance of final filters is 1.5 inches W.G.

The filter shall be classified by Underwriters' Laboratories Class 2 when tested according to UL Standard 900.

2.5 FANS

- A. The fan shall be a single-width, single-inlet, multiblade-type, plenum fan. The fan blades shall be backward-inclined airfoil. Plenum fans shall be equipped with self-aligning, antifriction, pillow-blocking bearings with an L-50 life of 200,000 hours as calculated per ANSI/AFBMA Standard 9.
- B. Supply fan performance shall be certified as complying with ARI Standard 430. Centrifugal fans shall be dynamically balanced at the factory as a complete fan assembly (fan wheel, motor, drive and belts). Fan shafts shall not pass through their first critical speed at any cataloged rpm.

- C. Fans shall be equipped with self-aligning, anti-friction pillow block bearings with a minimum life of L-50 200,000 hours. Bearings shall be equipped with grease lines allowing for lubrication from one side of the fan.
- D. Fan and motor assembly to be internally isolated from unit casing with spring isolators, furnished and installed by unit manufacturer.
- E. Sound data shall be provided using ARI 260 test methods. Unit discharge, inlet, and radiated sound power levels in dB shall be provided for 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hz. If a manufacturer cannot provide sound data per ARI 260 they may choose to have the air handlers field tested to ensure they meet the specified sound criteria. No exceptions to this requirement will be allowed.
- F. If multiple fans are used for an AHU, the manufacturer shall provide a single unit mounted NEMA 4 UL508A listed control panel with all fans in an array pre-wired to it, such that one properly sized VFD may be field connected with no additional provisions required for protection of the individual motors. A single power distribution block shall be provided for connection of the field mounted VFD with one conductor per phase. Class J or Class CC fusing and an electronic motor overload protector with manual isolation switch shall be provided for each motor in the array. Each motor in the array shall be independently grounded with a dedicated green conductor. A minimum of one open ground lug shall be provided for field use.

2.6 MOTORS AND DRIVES

- A. Motors shall be mounted integral to an isolated fan assembly furnished by the unit manufacturer. Motors shall be mounted inside the unit casing. Motor mounts shall be adjustable to permit drive belt tensioning.
- B. Drives shall be variable pitch for constant volume applications, suitable for adjustment within five percent of specified rpm. Drives shall be fixed pitch for variable air volume applications. Drives shall be selected at 1.2 service factor.
- C. Provide premium efficient motors.

2.7 COILS

- A. Coils shall be manufactured by the same company as the supplier of the air handling unit. Coils shall be designed with aluminum plate fins and copper tubes.
- B. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall be mounted in the unit casing to be accessible for service and can be removed from the unit either through the side or top. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 410.
- C. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.

2.9 OUTSIDE AIR/RETURN AIR DAMPERS

- A. A module shall be provided that supports damper assembly for outside air and return air.

- B. Dampers shall modulate the volume of outside and return air. Dampers shall be Ruskin CD60 type double-skin airfoil design or equivalent with metal compressible jamb seals and extruded vinyl blade edge seals on all blades. The dampers shall be rated for a maximum leakage rate of less than 1 percent of nominal airflow at 1 inch wg. Blades shall rotate on stainless steel sleeve bearings. Dampers shall be arranged in parallel or opposed blade configuration.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and in conformance with ARI 430.
- B. Install unit on vibration isolators. Refer to specifications where applicable.
- C. Because of phased construction and mechanical room constraints, the manufacturer shall make provisions for the air handlers to be field assembled, if required. The Mechanical Contractor shall coordinate installation of the air handlers with the General Contractor, prior to construction of mechanical room walls. The cost of assembly shall be included as a basic part of this project.
- D. The Contractor shall make condensate drain connections at all drain pan pipe fittings furnished with the unit and manifold them to a single condensate trap, then slope/pipe to room floor drain. The condensate drain shall be configured and dimensioned to remove all condensate from the drain pan in accordance with the manufacturer's recommended dimensional formula. The dimensional data shown on the drawing details should be used as a guide only. The installed trap shall have a minimum 4 inch height differential between the unit drain connection and trap discharge.
- E. Provide coil piping insulation flush and tight against side of unit. Provide a bead of caulk to insure the integrity of vapor seal.
- F. Seal any penetration in unit caused by cutting casing or mounting devices to unit.
- G. Start-up Checklist Items:
 - 1. Check to insure condensate trap is effective. With the unit operating, check condensate flow then open the fan section access door. If the flow does not increase dramatically with the door open, the trap is correct. If the flow increases significantly, then the trap is incorrect and the unit must be properly trapped.
 - 2. Do not run air unit at below 60 degree leaving air temperature until the building is closed up and controls are fully functional. Running equipment at low leaving air temperatures during building construction may result in permanent damage to unit, ductwork, and pipe insulation.
 - 3. Set controls to provide 15 minute dry down cycle. Unit fan should run for 15 minutes after chilled valve is closed.

*** END OF SECTION 23 73 13 ***

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SECTION 23 81 26 - SPLIT-SYSTEM AIR CONDITIONERS

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 split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. LEED Submittals (if required):
 - 1. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.
 - 2. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

- D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. Air handler units shall be completely factory assembled including coil, condensate drain pan, fan motor(s), filters, and controls in an insulated casing that can be applied in either vertical or horizontal configuration. Units shall be rated and tested in accordance with ARI Standards 210, 240, 360. Units shall be UL listed and labeled in accordance with UL 465/1995 for indoor blower coil units. All units shall be CSA certified for Canadian application.
- F. Unit capacities shall be certified with Air Conditioning and Refrigeration Institute Standard 210.
- G. Units shall be listed with Underwriters Laboratory, UL Standard for indoor blower coil units.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 07 Section "Roof Accessories."

1.6 WARRANTY

- A. The refrigeration equipment manufacturer's warranty shall cover material and workmanship that prove defective for a period of one year from date of equipment start up but not more than 18 months from date of shipment. Including refrigerant.
- B. EXTENDED WARRANTY: Provide an extended warranty to extend upon completion of year one through year five. The warranty shall cover materials that prove defective within the extended period, including refrigerant.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: Two spare sets with unit for a total of 3 sets.
 - 2. Fan Belts: One set of belts for each unit.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Basis of Design: Trane
 - 2. Daikin.

3. Carrier
4. Other Substitutes—Submit a written substitution request, prior to bid, to the Architect/Engineer in accordance with Basic Mechanical Requirements. Accepted substitutes will be notified via Addendum.

2.2 COMPONENTS

- A. Chassis: Zinc coated, heavy gauge, galvanized steel with flanged edges, removable panels for servicing with captive screws, knockouts for electrical power and refrigerant piping connections, and completely insulated.
 1. Insulation: Cleanable, foil faced, fire retardant, permanent, odorless glass-fiber material.
 2. Drain Pans: Provide a double sloped condensate drain pan constructed of PVC plastic. The drain pan shall be removable for cleaning. The condensate drain pan can be installed in any of four positions allowing for vertical or horizontal application and providing external connections on either side of the unit. Drain pan shall be insulated and comply with ASHRAE 62.1.
 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve. Coil shall be 3/8" internally enhanced copper tubing and factory pressure and leak tested at 375 psig.
- C. Electric Coil: Helical, heavy-duty nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection. UL and CSA approved electric heat modules shall be available for installation directly on fan discharge. Electric heaters shall be available in a wide range of capacities with one or two stage control, single-point electric power connection and terminal strip connections. Electric heater elements shall be internally wye connected on 480/600 volt, three phase, and delta connected on 208/240 volt, three phase. Each 208/240 volt heater shall have pilot duty with secondary backup fuse links for automatic reset of high limit controls. Each 480/600 volt heater shall have automatic line break high limit controls. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
- D. Fan: Centrifugal-type, forward-curved, double inlet, double-width wheel of galvanized steel; directly connected to motor with adjustable belt drive. Fan and motor bearings shall be permanently lubricated.
- E. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 1. Special Motor Features: Resilient mounted, multitapped, multispeed with UL Listed internal thermal protection and permanent lubrication. Oversized motors shall be available as an option for high static application. Motor bearings shall be of the sleeve type or ball bearing type with oversized oil reservoirs. Motors shall be permanent split capacitor. Shaded pole motor will not be acceptable. Electrical junction boxes shall be provided for single point power connection.

- F. Disposable Filters: 1 inch thick, in fiberboard frames with ASHRAE 52.2 MERV rating of 7 or higher.
- G. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- H. Controls: Magnetic evaporator fan contactor, low voltage terminal strip, check valve(s), and single point power entry shall be included. All necessary controls shall be factory installed and wired. Evaporator defrost control shall be included to prevent compressor slugging by temporarily interrupting compressor operation when low evaporator coil temperatures are encountered.

2.3 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Control for HVAC".
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work and opening dimensions are as instructed by the manufacturer.
- B. Verify that required utilities are available, in proper location, and ready for use.
- C. Beginning of installation means installer accepts existing surfaces.

3.2 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- D. Protect units with protective covers during balance of construction.
- E. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to unit to allow service and maintenance.

- C. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.4 AIR HANDLER SCHEDULE

- A. Refer to drawings.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Inspect for physical damage to unit casing.
 - 2. Verify that access doors move freely.
 - 3. Clean units and inspect for construction debris.
 - 4. Verify that all bolts and screws are tight.
 - 5. Adjust vibration isolation and flexible connections.
 - 6. Verify that controls are connected and operational.
- C. Lubricate bearings on fans.
- D. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
- E. Contractor shall notify manufacturer when equipment is ready for start-up. Manufacturer shall start unit and complete startup checklist.
- F. Measure and record airflow over coils.
- G. Verify proper operation of capacity control device.
- H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- I. Contractor shall correct any identified deficiencies until manufacturer start-up is complete.
- J. After startup and performance test, lubricate bearings.
- K. Provide initial and cooling season start-up, and winter season shut down during first year of operation, including routine servicing and check out.

- L. Provide initial charge of refrigerant and oil for each refrigerant circuit. Replace losses of refrigerant and oil.
- M. Inspect and test for refrigerant leaks every 3 months during first year of operation, and repair leaks.
- N. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- O. Remove and replace malfunctioning units and retest as specified above.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

*** END OF SECTION 23 81 26 ***

SECTION 23 82 19 - FAN COIL UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

- A. BAS: Building automation system.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. LEED Submittals:
 - 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
- C. 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. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For fan-coil 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. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.
- F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

- A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate size and location of wall sleeves for outdoor-air intake. Refer to drawings for requirements.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: Two spare sets with unit for a total of 3 sets.
 - 2. Fan Belts: One set of belts for each unit.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

2.2 FAN-COIL UNITS

- A. Basis-of-Design Product: TRANE or a comparable product by one of the following:
 - 1. Daikin
 - 2. Carrier.
 - 3. Other Substitutes—Submit a written substitution request, prior to bid, to the Architect/Engineer in accordance with Basic Mechanical Requirements. Accepted substitutes will be notified via Addendum.
- B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

- C. Coil Section Insulation: 1-inch thick, foil-covered, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
 - 1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Main: Insulated galvanized steel with plastic liner with positive slope. Fabricate pans and drain connections to comply with ASHRAE 62.1-2004.
- E. Auxiliary Drain Pans: Plastic
- F. Chassis: Zinc coated, heavy gauge, galvanized steel with flanged edges, removable panels for servicing with captive screws, knockouts for electrical power and refrigerant piping connections, and completely insulated.
- G. Cabinet: Steel with baked enamel finish in manufacturer's standard paint color as selected.
- H. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Glass Fiber Treated with Adhesive: MERV 13.
- i. Hydronic Coils: ½ inch O.D. copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, leak tested with air underwater and rated for a minimum working pressure of 300 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- J. Electric-Resistance Heating Coils: Helical, heavy-duty nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection. UL and CSA approved electric heat modules shall be available for installation directly on fan discharge. Electric heaters shall be available in a wide range of capacities with one or two stage control, single-point electric power connection and terminal strip connections. Electric heater elements shall be internally wye connected on 480/600 volt, three phase, and delta connected on 208/240 volt, three phase. Each 208/240 volt heater shall have pilot duty with secondary backup fuse links for automatic reset of high limit controls. Each 480/600 volt heater shall have automatic line break high limit controls. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
- K. Fan and Motor Board: Removable.
 - 1. Fan: Centrifugal-type, forward-curved, double inlet, double-width wheel of galvanized steel; directly connected to motor with adjustable belt drive. Fan and motor bearings shall be permanently lubricated. (Plastic fan wheels and blower housings are not acceptable.)

2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - a. Special Motor Features: Resilient mounted, multitapped, multispeed with UL Listed internal thermal protection and permanent lubrication. Oversized motors shall be available as an option for high static application. Motor bearings shall be of the sleeve type or ball bearing type with oversized oil reservoirs. Motors shall be permanent split capacitor. Shaded pole motor will not be acceptable. Electrical junction boxes shall be provided for single point power connection.
 3. Wiring Termination: Connect motor to chassis wiring with plug connection.
- L. Controls: Unit mounted multiple speed switch with auxiliary contacts.
- M. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fan-coil units level and plumb.
- B. Install fan-coil units to comply with NFPA 90A.
- C. Suspend fan-coil units from structure with elastomeric hangers. Refer to Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation
- E. Install new filters in each fan-coil unit within two weeks after Substantial Completion.
- F. Protect units with protective covers during balance of construction.
- G. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 - 1. Install piping adjacent to machine to allow service and maintenance.
 - 2. Connect condensate drain to indirect waste.
 - a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
- B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FAN COIL SCHEDULE:

- A. Refer to drawings.

3.5 FIELD QUALITY CONTROL

- A. 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 motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

*** END OF SECTION 23 82 19 ***

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SECTION 23 82 39 - ELECTRIC DUCT HEATERS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Electric Duct Heaters.

1.2 REFERENCES

- A. ANSI/ARI 410—Forced-Circulation Air-Cooling and Air- Heating Coils.
- B. ANSI/NFPA 70—National Electrical Code.
- C. ANSI/UL 1096—Electric Central Air Heating Equipment.
- D. SMACNA—Metal Duct Standards.
- E. Ducted Electric Heat Guide for Air Handling Systems, SMACNA, Inc.

1.3 QUALITY ASSURANCE

- A. Fabrication: Conform to applicable standards.
- B. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 15010 and Division 1.
- B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
- C. Product data shall indicate dimensions, weights, capacities, ratings, and gages and finishes of materials.
- D. Submit manufacturer's installation instructions under provisions of Division 1.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Division 1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 1 in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs.
- B. Store and protect products under provisions of Division 1.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean and controls have been tested.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Indeeco.
- B. Markel.
- C. Warren.

2.2 GENERAL

- A. The Contractor shall furnish and install the duct mounted electric heaters as shown and scheduled on the plans. The electric duct heaters shall be installed in strict accordance with the specifications. Unit shall be complete with controls, wiring, fuses, safety devices, control panels, thermostats, etc., as required for a complete and operating system.

2.3 ELECTRIC DUCT HEATERS

- A. Heaters and panelboards shall meet the requirements of the National Electrical Code and shall be listed by Underwriter's Laboratories for zero clearance to combustible surfaces and for use with heat pumps and air conditioning equipment.
- B. Heating elements shall be open coil, 80% nickel, 20% chromium, type A resistance wire. Type C alloys containing iron or other alloys are not acceptable. Coils shall be machine crimped into stainless steel terminals extending at least 1" into the airstream and all terminal hardware shall be stainless steel. Coils shall be supported by ceramic bushings staked into aluminized steel supporting brackets.
- C. Heater frames and terminal boxes shall be aluminized steel. Unless otherwise indicated, the terminal box shall be NEMA 1 construction and shall be provided with a hinged, latching cover and multiple concentric knockouts for field wiring.
- D. All heaters shall be furnished with a disc type, automatic reset thermal cutout for primary overtemperature protection. All heaters shall also be furnished with disc type, load carrying manual reset thermal cutouts, factory wired in series with heaters stages for secondary protection. Heat limiters or other fusible overtemperature devices are not acceptable.
- E. Heaters shall be rated for the voltage, phase and number of heating stages indicated in the schedule. All three phase heaters shall have equal, balanced, three phase stages. All internal wiring shall be stranded copper with 105°C insulation and shall be terminated in crimped connectors or box lugs.
- F. Terminal blocks shall be provided for all field wiring and shall be sized for installation of 75°C copper wire rated in accordance with NEC requirements.
- G. Heaters shall be furnished with the Control Option specified below and as coordinated with the Controls Contractor.

- H. Provide thermal cutouts, airflow switch, SOLITECH SCRs, fuses, control circuit transformer and built-in, snap-acting, door interlocked disconnect switch.
- I. Provide heaters with insulated dust tight terminal box.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and in conformance with ARI and the SMACNA Ducted Electric Heat Guide for Air Handling Systems.
- B. Provide for connection to electrical service.
- C. Provide all clearances for maintenance and service as required by NEC and the manufacturer's installation instructions.
- D. Contractor shall remote mount the control panel as required by the field conditions. Coordination of control panel locations shall be completed prior to shop drawing/ submittal phase with all other trades to account for panel type prior to ordering equipment.
- E. Support coil sections independent of piping on steel channel or double angle frames and secure to casings. Provide frames for maximum three coil sections. Arrange supports to avoid piercing drain pans. Provide airtight seal between coil and duct or casing.
- F. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- G. Wire electric duct coils in accordance with ANSI/NFPA 70.

*** END OF SECTION 23 82 39 ***

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SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Basic electrical requirements specifically applicable to Division 26 Electrical.

1.2 SECTION INCLUDES

- A. Basic Electrical Requirements specifically applicable to Division 26 Sections, in addition to Division 01 General Requirements.

1.3 INTENT

- A. It is the intention of these specifications and drawings to call for finished work, tested, and ready for operation. Wherever the word "provide" is used, it shall mean "furnish and install complete and ready for use."
- B. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.

1.4 SURVEYS AND MEASUREMENTS

- A. Base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work. All material take-offs for the site shall be field measured prior to bids.

1.5 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the contract. Drawings are not to be scaled. The architectural drawings and details shall be examined for exact location of fixtures and equipment. Where they are not definitely located, this information shall be obtained from the Architect.
- B. If directed by the Architect or Engineer, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.
- C. At the time of each shop drawing submission, the Contractor shall call the Engineer's attention (in writing) to, and plainly mark on shop drawings, any deviations from the Contract Documents.
- D. Samples, drawings, specifications, catalogs, submitted for approval, shall be properly labeled indicating specific service for which material or equipment is to be used, location, section and article number of specifications governing, Contractor's name, and name of job. All equipment shall be labeled to match labeling on contract documents.

- E. Catalogs, pamphlets, or other documents submitted to describe items on which approval is being requested, shall be specific and identification in catalog, pamphlet, etc. of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.
- F. Approval rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are approved, said approval does not mean that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the contract drawings and specifications.
- G. All shop drawings shall be submitted to the A/E by Contractor no later than 30 days from the day of contract award.
- H. Failure of the Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension of contract time, and no claim for extension by reason of such default will be allowed.
- I. Submit all Division 16 submittals at one (1) time in one (1) integral group. Piece-by-piece submission of individual items will not be acceptable. Engineer may check contents of each submittal set upon initial delivery; if not complete as set forth herein, submittal sets may be returned to Contractor without review and approval and will not be accepted until made complete.
- J. At the close of the job, prior to final review, five (5) bound copies of the following shall be submitted by transmittal letter to the Engineer for review and acceptance.
 - 1. Equipment warranties
 - 2. Contractor's warranty
 - 3. Parts list and manuals for all equipment
 - 4. Operating Instructions (in writing)
 - 5. Written instructions on maintenance and care of the system

1.6 REFERENCES

- A. ANSI/NFPA 70—National Electrical Code.
- B. NFPA 101—Life Safety Code.

1.7 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Proposed Products List: Include Products specified in the following Sections, but not limited to:
 - 1. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.
 - 2. Section 26 05 26 Grounding and Bonding for Electrical Systems.
 - 3. Section 26 05 29 Hangers and Supports for Electrical Systems.

4. Section 26 05 33 Raceway and Boxes for Electrical Systems.
5. Section 26 05 53 Identification for Electrical Systems.
6. Section 26 09 23 Lighting Control Devices.
7. Section 26 24 16 Panelboards.
8. Section 26 27 26 Wiring Devices.
9. Section 26 28 16 Enclosed Switches and Circuit Breakers.
10. Section 26 29 13 Enclosed Controllers.
11. Section 26 32 13 Engine Generators.
12. Section 26 36 00 Transfer Switches.
13. Section 26 37 00 Above Ground Storage Tank Equipment (Diesel)
14. Section 26 41 13 Lightning Protection for Structures
15. Section 26 43 13 Surge Protective Devices (SPD's).
16. Section 26 51 00 Interior Lighting.
17. Section 26 56 00 Exterior Lighting

- C. It shall be understood that review of shop drawings by the Engineer does not supersede the requirement to provide a complete and functioning system in compliance with the Contract Documents.

1.8 SUBSTITUTIONS

- A. Materials and equipment are specified herein by a single or by multiple Manufacturers to indicate quality and performance required. The drawings are based upon equipment scheduled on drawings and specified. If another Manufacturer is considered for substitution during the bidding process, the Electrical Contractor shall be responsible for coordinating all electrical, mechanical, structural, or architectural changes. Comparable equipment Manufacturers which are listed as equals shall be considered as substitutes. Manufacturers other than the basis of design shall submit a catalog information and 1/4" scale plan and section drawings showing proper fit and all clearances for maintenance items.

- B. Substitutions of other Manufacturer's will be considered for use if, in the Engineers opinion, the item requested for substitution is equal to that specified. The Contractor shall provide to the Engineer a typed comparative list of the basis of design and the proposed substitute.

Request for approval of substitutions or equals prior to bid must be made in writing. The approval of any substitutions or equals prior to bid shall not be construed as a shop drawing approval. The substitute or equal must be submitted as described in the specifications and meet all the requirements of the specifications and drawings.

- C. All requests for substitutions shall be submitted as described in paragraph 1.07, B., and specifically indicate any and all differences or omissions between the product specified as basis of design and the product proposed for substitution.

- D. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawing, which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical or electrical, all such redesign, and all new drawings and detailing required therefore, shall be prepared by the Subcontractor at his own expense and submitted to the Architect/Engineer for approval.
- E. Where such approved deviation requires quantity and arrangement of equipment from that specified or indicated on the drawings, any other additional equipment required by the system, at no additional cost to the Owner.

1.9 COOPERATION WITH OTHER TRADES

- A. Give full cooperation to other trades and furnish in writing to the General Contractor, with copies to the Architect, any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- B. When work installed under this Division will be in close proximity to, or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer/Architect, prepare composite working drawings and sections at a suitable scale not less than $1/4" = 1'0"$, clearly showing how work is to be installed in relation to the work of other trades. If the work is installed before coordinating with other trades, or so as to cause any interference with work of other trades, make all the necessary changes in work to correct the condition without extra charge.
- C. Furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

1.10 ELECTRICAL UTILITY COORDINATION

- A. The contractor shall arrange with Utility Company for permanent electric service including payment of Utility Company charges for service.
- B. Service shall be underground Service Entrance. System Voltage: 208 volts, three phase, four-wire, 60 Hertz.
- C. Utility Company: Progress Energy:
 - 1. Contact Information: Joel Good, Distribution Engineering Department, (727) 372-5176.
- D. Install service entrance in accordance with Utility Company's rules and regulations.
- E. The utility company shall provide the primary utility conduits and the Electrical Contractor shall install the conduits as directed by the utility company. The utility company shall provide and install the primary conductors.

1.11 PROTECTION

- A. Protect all work and material provided under this Division from damage. All damaged equipment work or material provided under this Division shall be replaced with new. Rebuilds are not acceptable.

- B. Protect all work and equipment until inspected, tested, and accepted. Protect work against theft, injury, or damage; and carefully store material and equipment received on site which are not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of obstructing material.

1.12 SCAFFOLDING, RIGGING, AND HOISTING

- A. Provide all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished. Remove same from premises when no longer required.

1.13 REMOVAL OF RUBBISH

- A. This Contractor shall at all times keep premises free from accumulations of waste materials or rubbish caused by his employees or work. At completion of work he shall remove all his tools, scaffolding, materials, and rubbish from the building and site. He shall leave the premises and his work in a clean, orderly, and acceptable condition.

1.14 SAFETY

- A. This Contractor shall comply with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.333), Title 29—Labor, Chapter XIII, Bureau of Standards, Department of Labor, Part 1518—Safety and Health Regulations for Construction; and that his housekeeping and equipment be maintained in such a manner that they comply with the Florida Industrial Commission Safety Code and Regulations of the Federal Williams—Steiger Occupational Safety and Health Act of 1970 (OSHA), wherein it states that the Contractor shall not require any laborer or mechanic employed in the performance of the contract to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health and safety.

1.15 SUPERVISION

- A. This Contractor shall provide a competent, experienced, full time superintendent who is acceptable to the Architect/Engineer and Owner, and who is authorized to make decisions on behalf of the Contractor.

1.16 MATERIAL AND WORKMANSHIP

- A. All materials and apparatus required for the work, except as specifically specified otherwise, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article as approved by the Engineer shall be furnished. Refer to substitutions in this Section.
- B. Unless otherwise specifically indicated on the plans or specifications, all equipment and materials shall be installed with the approval of the Architect and Engineer in accordance with the recommendations of the Manufacturer. This includes the performance of such tests as the Manufacturer recommends.

1.17 QUIET OPERATION AND VIBRATION

- A. All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Engineer and the Owner. In case of moving machinery, sound, or vibration noticeable outside of room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Engineer and the Owner shall be corrected in an approved manner at no additional expense to the Owner.

1.18 FOUNDATIONS, SUPPORTS, PIERS, ATTACHMENTS

- A. This Contractor shall furnish and install all necessary foundations, supports, pads, bases and piers required for all equipment furnished under this Division, and shall submit drawings to the Architect and Engineer for approval before purchase, fabrication or construction of same.
- B. For all floor mounted equipment, provide concrete pads which extend six inches (6") beyond equipment base in all directions with top edge chamfered. Inset six inches (6") steel dowel rods into floors to anchor pads. Shop drawings of all foundations and pads shall be submitted to the Architect and Engineer for approval before same are constructed.
- C. Construction of foundations, supports, pads, bases, and piers where mounted on the floor, shall be the same materials and same quality of finish as the adjacent and surrounding flooring material.
- D. All equipment, unless shown otherwise, shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Architect and the Engineer, not strong enough shall be replaced as directed.

1.19 ACCESS DOORS FOR WALLS AND CEILINGS

- A. Provide flush panel access doors with a 16 gauge steel frame and a 14 gauge steel door panel.
- B. Finish is to be primed painted steel.
- C. Provide concealed hinges which allow the door to open 175 degrees and have a removable pin.
- D. Provide access doors with a locked flush mounted vandal proof spanner head operated steel cams.
- E. Provide 1-1/2 hour "B" label door for rated chase walls.
- F. Furnish masonry anchors for installation in masonry walls and metal lath wings with casing bead for plaster installation.
- G. Provide a minimum 2'-0" by 2'-0" access doors unless shown or noted otherwise on the drawings.
- H. Access doors for chase walls shall be mounted 16" off the finish floor.
- I. Access doors for electrical equipment shall be a minimum of 12" larger than equipment all around.

1.20 REGULATORY REQUIREMENTS

A. Conform to applicable Codes and Standards as follows:

1. Standard:

- a. Certain standard materials and installation requirements are described by reference to standard specifications. These standards are as follows:

NEMA..... National Electrical Manufacturers Association.

UL Underwriters Laboratories.

ANSI..... American National Standards Institute.

For additional standards and requirements see other sections of the specifications.

Whenever a reference is made to a standard, installation and materials shall comply with the latest published edition at the time project is bid unless otherwise specified herein.

2. Codes and Rules:

- a. All material furnished and all work installed shall comply with the following codes as they apply to this project:

☐ NFPA 70 and NFPA 101.

☐ Regulations of the Florida Industrial Commission Concerning Safety.

☐ Applicable County, State, and Local Building Codes.

☐ Local and State Fire Marshal Rules and Regulations.

☐ Chapter 4A-47, Florida Administrative Code - Uniform Fire Safety Standards for Elevators.

☐ Occupational Safety and Health Agency Standards (OSHA).

☐ Florida State Board of Health Rules and Regulations.

☐ Florida Building Code.

Applicable codes shall be those adopted by the authority having jurisdiction at the time project is bid.

3. Permits, Fees and Inspections

- a. The Contractor shall give all necessary notices, obtain all permits and pay all government fees, sales taxes and other costs, including utility connections or extensions, in connection with this work; file all necessary approvals of all governmental departments having jurisdiction.

- b. Obtain all required certificates of inspection for his work and deliver to the Owner/Engineer the same certificates before request for acceptance and final payment for the work.
- c. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and drawings required to comply with all applicable laws, ordinances, rules and regulations.
- d. The Contractor shall inform the Engineer of any work or materials which conflict with any of the applicable codes, standards, laws and regulations before submitting his bid.

1.21 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Architect/Engineer before proceeding.
- C. The Contractor shall inform the Engineer of any work or materials which conflict with any of the applicable codes, standards, laws and regulations before submitting his bid.
- D. The scope of the work included under this Division of the Specifications shall include complete electrical systems as shown on the plans and as specified herein. The General Conditions and Special Conditions of these specifications shall form a part and be included under this Section of the Specifications. Provide all supervision, labor, material, equipment, machinery, factory trained personnel, and any and all other items necessary to complete the electrical systems. All items of equipment are specified in the singular; however, provide and install the number of items of equipment as indicated on the drawings, and as required for complete systems.

1.22 SEQUENCING AND SCHEDULING

- A. Construct Work in sequence under provisions of Division 1.

1.23 LICENSE

- A. The Subcontracting Firm for the electrical and systems installation shall be licensed by the State of Florida and the local authorities, regularly engaged in the installation of electrical systems and other related equipment. The Subcontracting Firm shall be familiar with all local conditions including interpretations, codes and shall have at least 5 years of successful installation experience on similar projects of the same magnitude and scope.

The Subcontracting Firm shall list at least three projects it has successfully completed over the last five years for proof of experience of this caliber. This list shall be included with submittals for review by Architect/Engineer. The Subcontracting Firm shall hold a Florida State Certified Electrical Contractor license for this project. The Subcontracting firm for the fire alarm system shall be a certified "EF" installer.

1.24 AS-BUILT DRAWINGS

- A. This Contractor shall provide AutoCad as-built drawings and copies of each AutoCad file on CD before final payment will be issued.

*** END OF SECTION 26 05 00 ***

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SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
 - 4. Conductor sizes are based on copper.
- B. Related Sections include the following:
 - 1. Section 26 05 33 Raceway And Boxes For Electrical Systems.
 - 2. Section 26 05 53 Identification For Electrical Systems.

1.3 REFERENCES

- A. ANSI/NFPA 70—National Electrical Code.
- B. NEMA WC5—Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

1.4 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- 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 NFPA 70 where wire and cable is not shown.

1.7 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- B. Determine required separation between cable and other work.

PART 2 PRODUCTS

2.1 CONDUCTORS AND CABLES

- 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. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
- C. Copper Conductors: Comply with NEMA WC 70.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.
- E. Multiconductor Cable: Comply with NEMA WC 70 for Type SO with ground wire.

2.2 CONNECTORS AND SPLICES

- 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. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

- 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. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- C. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Carbon steel. Include two for each sealing element.

3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

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. Stranded for No. 12 AWG and larger.
- C. Branch circuit neutral conductors shall be no less than No. 10 AWG.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN-XHHW, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- F. Feeders in Cable Tray: Type THHN-THWN, single conductors in raceway.
- G. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- K. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- L. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- M. Class 2 Control Circuits: Type THHN-THWN-TFFN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Concealed Dry Interior Locations: Use only building wire and cable (all types) in raceway.
- E. Exposed Dry Interior Locations: For feeders, branch circuits, and class 1 remote control circuits, use only building wire in raceway. For class 2 or 3 control cable and power limited fire protective signaling cables run in raceway.
- F. Above Accessible Ceilings: For feeders, branch circuits and class 1 remote control cables use only building wire in raceway. For class 2 or 3 remote control cables run exposed. For power limited fire protective signaling cables run in raceway.
- G. Wet or Damp Interior Locations: For feeders, branch circuits and class 1 remote control cables use only building wire in raceway. For class 2 or 3 remote control cable and power limited fire protective signaling cables run in raceway.
- H. Exterior Locations: For feeders, branch circuits and class 1 remote control cables use only building wire run in raceway. For class 2 or 3 remote control cables and fire protective signaling cables run in raceway.
- I. Underground Installations: For feeders, branch circuits and class 1 remote control cables use only building wire run in raceway. For class 2 or 3 remote control cables and for power limited fire protective signaling cables run in raceway.
- J. Use wiring methods indicated on Drawings.
- K. Each computer/clean power receptacle and lighting circuits shall have a dedicated neutral conductor.
- L. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.
- M. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

- N. All conductors size #6 and smaller shall be color coded insulation. Equipment grounding conductors #6 and smaller to have green or bare exterior finish per NEC 250-119(A). Grounded conductors (neutral) #6 and smaller to have a white or grey exterior finish per NEC 200-6. Conductors size #4 and larger shall be color code by use of colored plastic tape applied within 6" of each conductor end. All color coding shall be with the same color being used with its respective phase or bus through the entire job as follows:

208/120 VOLTS	277/480 VOLTS
Phase A.....Black	Phase A Brown
Phase B.....Red	Phase B Orange
Phase C Blue	Phase C Yellow
Neutral.....White	Neutral Gray
Ground Green	Ground Green

- O. Grounding conductors shall be identified with a continuous outer finish that is either green, or green with one or more yellow stripe.
- P. Protect exposed cable from damage.
- Q. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
- R. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- S. Clean conductor surfaces before installing lugs and connectors.
- T. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- U. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- V. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- W. Terminate spare conductors with electrical tape.
- X. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- Y. Splice only in accessible junction boxes.
- Z. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both wall surfaces.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- J. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- L. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
 - a. Subpanels.
 - b. Mechanical equipment with service of 200 amps and greater.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan on equipment and connections identified by the Engineer. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. 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 Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning units and retest as specified above.

*** END OF SECTION 26 05 19 ***

SECTION 26 05 23 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Low-voltage control cabling.
 - 2. Control-circuit conductors.
 - 3. Identification products.

1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Maintenance Data: For wire and cable to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- 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.

PART 2 PRODUCTS

2.1 PATHWAYS

- A. All control wiring shall be run in a raceway.

2.2 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMP.
 - 1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with NFPA 262.
- B. Paired Cable: NFPA 70, Type CMP.
 - 1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
 - 2. Fluorinated ethylene propylene insulation.
 - 3. Unshielded.
 - 4. Plastic jacket.
 - 5. Flame Resistance: NFPA 262, Flame Test.

2.3 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, power-limited tray cable, in cable tray, power-limited cable in raceway when concealed in building finishes, complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

2.4 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Brady Corporation.
 - 2. HellermannTyton.
 - 3. Kroy LLC.

- 4. Panduit Corp.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

PART 3 EXECUTION

3.1 COORDINATION

- A. Refer to Division 27 Drawings and Specifications for interbuilding backbone cabling.

3.2 INSTALLATION OF PATHWAYS

- A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- B. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets and terminals.
 - 2. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables.

3.5 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No 14 AWG.
 - 2. Class 2 low-energy, remote-control, and signal circuits, No. 16.
 - 3. Class 3 low-energy, remote-control, alarm, and signal circuits, No 12.

3.6 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.7 GROUNDING

- A. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Provide continuous grounding conductor along with control circuit conductors within raceway.

3.8 IDENTIFICATION

- A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect cable placement, cable termination, grounding and bonding.
- D. Prepare test and inspection reports.

*** END OF SECTION 26 05 23 ***

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.
 - 1. Underground distribution grounding.
 - 2. Common ground bonding with lightning protection system.

1.3 SYSTEM DESCRIPTION

- A. Ground the electrical service system neutral at service entrance equipment to metallic water service, concrete encased rebar, building steel, and to supplementary grounding electrodes.
- B. Ground each separately-derived system neutral to nearest effectively grounded metallic water pipe, concrete encased rebar, nearest effectively grounded building structural steel member, and separate grounding electrode.
- C. Provide communications system grounding conductor at point of service entrance and connect to separate grounding electrode.
- D. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.
- E. Install lightning surge protection on all service entrances as shown on drawings. Lightning surge protector shall have a minimum withstand rating of a Class "C" test.
- F. Bond metallic gas piping with #4 AWG copper conductor.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.

- 5. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems based on NETA MTS.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- 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 UL 467 for grounding and bonding materials and equipment.
- D. Grounding system resistance shall not exceed 10 ohms.
- E. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method. Submit test results to Engineer for review and approval immediately upon completing the test and prior to energizing new utility service. The testing shall include sufficient ground resistant data readings from distances up 100 feet away from the ground triad in order to plot a distinct plateau between two distinctive slopes.

PART 2 PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 4 inches in cross section, unless otherwise indicated; with insulators, length as required for number of terminations plus 25 percent future capacity.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory 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, bolted pressure-type, with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad; sectional type, 3/4 inch by 10 feet in diameter, two (2) rods coupled together for overall length of 20 feet.

PART 3 EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Ring Conductors: Install bare-copper conductor, No. 4/0 AWG minimum when indicated on the drawings to provide.
1. Bury at least 24 inches below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

- C. 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.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall, 6 inches above finished floor, unless otherwise indicated.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Clamp connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.

8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- D. Metal and Concrete Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors. Provide ground rod at each location.

3.4 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. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Ground Ring (when identified and called for on the drawings): Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of item indicated.
1. Install copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than 24 inches from building foundation.
- H. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed the following values:
1. Main service equipment and distribution gear.
 2. Separately derived system (i.e., transformers, uninterruptible power supply, engine generators).
 3. Grounding system resistance shall not exceed 10 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect/Engineer promptly and include recommendations to reduce ground resistance.
- D. Supplement by adding additional ground rods to achieve 10 ohms.

*** END OF SECTION 26 05 26 ***

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SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including 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.
 - 3. Supports/safety wire and chains for light fixtures and equipment.
- B. Related Sections include the following:
 - 1. Division 26 Section "Interior Lighting and Theatrical Lighting."

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. 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.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "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. 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:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - 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. Located In or Around Cooling Tower Yards: Pipe hangers, equipment supports, miscellaneous structure components, hardware, bolts, washers, nuts, screws, etc., shall be non-metallic polyester resin, vinyl ester resin, fiberglass, glass reinforced polyurethane, or 316 stainless steel.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for 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.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 1. Powder-Actuated Fasteners: Shall not be used.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - 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) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment. After fabrication shall be coated with hot-dipped galvanized with a minimum of 1.50 oz/ft on all sides.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.
- C. Field cuts shall be zinc coated.

2.3 SAFETY WIRE, CABLES, AND CHAIN

- A. Chain, General Specifications: Equivalent to Campbell Chain Company's specified system of steel, electrically welded standard finish (do not galvanize or electroplate), in continuous lengths. Comply with Manufacturer's recommendations.
- B. Drop Forged Chain Fittings (eye bolts, pad eyes, links, chain shackles, snaps, anchor shackles, swivels, turn buckles): Of the same materials and finish as the chain and of the same or greater working load limits, of the same manufacturer or as may be specifically recommended by the chain manufacturer.
- C. General Specifications for Wire: 8-gauge galvanized annealed steel wire (multiple strands of lesser gauge will not be considered acceptable). Each wire shall, itself, be looped through the building structural framing above and not to other wiring systems. The angle of the wires shall be kept as vertical as possible and not over 45 degrees from the vertical.
- D. Cable for Exposed-to-Public-View-Applications: Where suspended chandeliers, light fixtures, or special equipment occurs, stainless steel flexible aircraft cable or stainless steel flexible marine cable, 302/304, as manufactured by Paulsen, or equal, or Sailbryte as manufactured by Macwhyte corrosion resistant stainless steel or better, right regular lay, in continuous lengths, shall be used. Comply with manufacturer's recommendations.
- E. Forged and other stainless steel fittings for stainless steel aircraft or marine cable (turnbuckles, swagings, Nicro-Press sleeves, wire rope clips, use only in concealed positions), connecting links shoulder rivets, jaw fittings, eye fittings, lifting eyes, thimbles, swivels, eye nuts, heavy thimbles, clevis nuts, eye pads, shoulder pins); of same material, of same or greater working loads limits as the cable, of the same manufacturer or as recommended by the cable manufacturer, of type 304/316 electro-polished finish, drop forged, non-magnetic (when available for particular fitting). Manufactured by Merrill or equal. See Workmanship paragraph below.
- F. Stainless steel cable for loads (per cable) not exceeding 100 lbs.: 3/32" 7x19 with tensile load limit of 920 lbs. minimum.
- G. Stainless steel cable for loads (per cable) not exceeding 500 lbs.: 3/16" 7x19 with tensile load limit of 3,700 lbs. minimum.

- H. Workmanship: Stainless steel cable is required to be used only in areas where such is exposed to "public view" therefore only fittings designed for cold swaging or Nicro-Press fittings or swagless terminals such as Macwhyte Norseman Terminals are to be used whereby no wire ends, nuts, pins, or cotter keys, or clips are visible. Swaging shall be done only with a rotary swager (not a roll swager.) Manufacturer's recommendations and specifications shall be adhered to. Pertinent portions of the booklet Wire Rope Facts published by Banks Wire Rope and Sling, Inc. (available in Tampa) and Construction Care and Maintenance of Marine Rigging by Macwhyte Wire Rope Company (available at the Lazzerette Company) which may pertain also to stainless steel cable, shall be adhered to.

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 required by 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 conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. 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.
- C. 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 Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 3. To Existing Concrete: Expansion anchor fasteners.
 4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 5. To Light Steel: Sheet metal screws.

6. 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].
 7. Do not drill structural steel members.
- D. 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 Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 Painting Sections 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 26 05 29 ***

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SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Section 26 05 26 Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 29 Hangers and Supports for Electrical Systems.
 - 3. Section 26 05 53 Identification for Electrical Systems.
 - 4. Section 26 27 26 Wiring Devices.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: All raceway types, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
 - 2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.

- b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alfex Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. Manhattan/CDT/Cole-Flex.
 - 7. Maverick Tube Corporation.
 - 8. O-Z Gedney; a unit of General Signal.
 - 9. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1. Zinc coated $\frac{3}{4}$ " minimum.
- C. Aluminum Rigid Conduit: ANSI C80.5.

- D. IMC: ANSI C80.6.
- E. EMT: ANSI C80.3. $\frac{3}{4}$ " minimum.
- F. LFMC: Flexible steel conduit with PVC jacket.
- G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Steel set screw or steel compression. One inch (1") and smaller shall be insulated throughout.
 - 2. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 3. Fittings for EMT: Steel, set-screw or compression type.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.
 - 7. ElecSYS, Inc.
 - 8. Electri-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT/Cole-Flex.
 - 11. RACO; a Hubbell Company.
 - 12. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.

- C. RNC: NEMA TC 2, Type EPC-40-PVC and EPC-80-PVC. $\frac{3}{4}$ " minimum.
- D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Arnco Corporation.
 - 2. Endot Industries Inc.
 - 3. IPEX Inc.
 - 4. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible type, approved for plenum installation.

2.4 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include 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 or screw-cover type, as indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.

- C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- D. Fittings and Accessories: Include 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.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Robroy Industries, Inc.; Enclosure Division.
 - 9. Scott Fetzer Co.; Adalet Division.
 - 10. Spring City Electrical Manufacturing Company.
 - 11. Thomas & Betts Corporation.
 - 12. Walker Systems, Inc.; Wiremold Company (The).
 - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Metal Floor Boxes: Cast metal, fully adjustable, rectangular. Hubbell B-4236 Series, Walker 880CS Series.
- E. Floor Box Covers: Polished solid brass.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- I. Cabinets:
 - 1. NEMA 250, Type 1, 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. Plywood backboard, marine-grade, 3/4" thick.
 - 7. Copper Ground Bar with #6 Copper Grounding: Electrode conductor to building steel.
 - 8. Terminal Blocks: ANSI/NEMA ICS 4: UL listed. Channel mounted tubular pressure screw connectors, rated 300 volts.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 - 1. Color of Frame and Cover: Gray.
 - 2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "ELECTRIC" or "COMMUNICATION."
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
 - 8. All in-ground boxes shall be traffic bearing type.

- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. 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:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide Quazite PG Series or a comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.

2.8 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.9 SLEEVE SEALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Carbon steel. Include two for each sealing element.

3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: Rigid steel conduit or EMT.
 3. Underground Conduit: RNC, Type EPC-40 PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 6. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete. SCTE 77, Tier 15 structural load rating.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
- B. Comply with the following indoor applications, unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

5. Damp or Wet Locations: Rigid steel conduit.
 6. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable in raceway or EMT.
 7. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 8. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: General-use, optical fiber/communications cable in raceway; Riser-type, optical fiber/communications cable in raceway. Outside Plant, Plenum-type, optical fiber/communications cable in RGC or IMC.
 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- 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. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of four 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

- H. Raceways Embedded in Slabs: Metallic raceways shall be coated with Bitumastic.
 - 1. Run conduit parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from Type EPC-40-PVC to rigid steel conduit or IMC before rising above the floor.
- I. 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.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use #12 insulated conductor or polypropylene line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations 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 at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
 - 1. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
 - 2. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

- O. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, 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.
- P. 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.
- Q. Set metal floor boxes level and flush with finished floor surface.
- R. Install insulated bushing on all conduits. Install grounded metal bushing with lug on all mains, sub-feeders, switchboards, panelboards, transformers, chillers, disconnects, starters, and equipment rated at 100 amps and above.
- S. Do not install flush mounting boxes back to back in walls. Provide minimum 12 inch separation. Provide 24 inch minimum separation in acoustic rated walls.
- T. Install boxes to preserve fire resistance rating of partitions and other elements using materials and methods that are UL listed and tested.
- U. Use stamped steel bridges to fasten flush mounted outlet box between studs.
- V. Existing Walls, Public Areas, Classrooms, Offices, Restrooms, Hallways, etc.: Conduit and boxes shall be concealed. Saw cut walls and floor slab. Make arrangements with General Contractor to patch all areas.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
 - 2. Install backfill as specified in Division 31 Section "Earth Moving."
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
 - 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

- b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
- 6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.
- 7. Transition from PVC (EPC-40 and EPC-80) to rigid galvanized conduit 5'-0" out from building foundation walls.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.8 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

*** END OF SECTION 26 05 33 ***

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SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including 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.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.
 - 9. Receptacle Labels.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. 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 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, Junction Boxes, and Pullboxes Carrying Circuits at 600 V or Less:
 - 1. Fire Alarm System: Red.
 - 2. Security: Pink.
 - 3. Communications: Black.
 - 4. Miscellaneous Communications: Brown.
 - 5. Life Safety: Yellow.
 - 6. Normal Low Voltage: Blue.
 - 7. Normal High Voltage: Green.
 - 8. Emergency Low Voltage: Grey.
 - 9. Emergency High Voltage: Orange.
 - 10. Tear-N-Go System (911 System): Purple.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high letters on 20-inch centers.
- D. Self-Adhesive 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 adhesive tape for securing ends of legend label.

- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

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 raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.4 FLOOR MARKING TAPE

- A. 2-inch wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.5 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.6 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- 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.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches.
- D. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.7 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 black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
- C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.9 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 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.
 - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 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.

4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 1. Minimum Width: 3/16 inch.
 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.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 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.

2.11 RECEPTACLE LABELS

- A. Laminated tape with adhesive backing, black letters on white background. Labels shall identify panelboard and branch circuit number.

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. 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 10-foot maximum intervals in straight runs, and at 5-foot maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

- 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. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits: Identify with self-adhesive vinyl label, self-adhesive vinyl tape applied in bands, or painted bands. 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:
 - 1. Fire Alarm System: Red.
 - 2. Security: Pink.
 - 3. Communications: Black.
 - 4. Miscellaneous Communications: Brown.
 - 5. Life Safety: Yellow.
 - 6. Normal Low Voltage: Blue.
 - 7. Normal High Voltage: Green.
 - 8. Emergency Low Voltage: Grey.
 - 9. Emergency High Voltage: Orange.
 - 10. Tear-N-Go System (911 System): Purple.
- C. Power-Circuit Conductor Identification, 600 V or Less: For all conductors.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.

- 2) Phase B: Red.
- 3) Phase C: Blue.
- c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 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.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 1. Comply with 29 CFR 1910.145.
 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. 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:

- a. Panelboards: Typewritten directory of circuits, specific to the load served and distinguishable from all other in the panel. The directory shall be placed in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- e. Emergency system boxes and enclosures.
- f. Enclosed switches.
- g. Enclosed circuit breakers.
- h. Enclosed controllers.
- i. Variable-speed controllers.
- j. Push-button stations.
- k. Power transfer equipment.
- l. Contactors.
- m. Remote-controlled switches, dimmer modules, and control devices.

- n. Battery-inverter units.
 - o. Battery racks.
 - p. Power-generating units.
 - q. Monitoring and control equipment.
 - r. UPS equipment.
3. Label Colors:
- a. Normal Power: Black.
 - b. Emergency Power: Orange.
 - c. Life Safety Power: Yellow.
 - d. Equipment Power: Green.

K. Receptacle Identification

- 1. Provide label on each receptacle wall plate, identifying panelboard and branch circuit number.

*** END OF SECTION 26 05 53 ***

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor photoelectric switches.
 - 3. Indoor occupancy sensors.
 - 4. Lighting contactors.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Intermatic, Inc.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lightolier Controls; a Genlyte Company.
 - 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 5. Paragon Electric Co.; Invensys Climate Controls.
 - 6. Square D; Schneider Electric.
 - 7. TORK.
 - 8. Touch-Plate, Inc.
 - 9. Watt Stopper (The).
- B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 - 1. Contact Configuration: DPDT or DPST as required.
 - 2. Contact Rating: 30-A inductive or resistive, 240-V ac, 20-A ballast load, 120/240-V ac, and 20 A ballast load, 277/480-V ac.
 - 3. Program: 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
 - 4. Astronomic Time: All channels.
 - 5. Battery Backup: For schedules and time clock.
- C. Electromechanical-Dial Time Switches: Type complying with UL 917.
 - 1. Contact Configuration: SPDT or DPDT.
 - 2. Contact Rating: 30-A inductive or resistive, 240-V ac; 20-A ballast load, 120/240-V ac; 20A ballast load, 277/480 V ac.
 - 3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
 - 4. Astronomic time dial.
 - 5. Eight-Day Program: Uniquely programmable for each weekday and holidays.

6. Skip-a-day mode.
7. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Intermatic, Inc.
 2. Lithonia Lighting; Acuity Lighting Group, Inc.
 3. Paragon Electric Co.; Invensys Climate Controls.
 4. Square D; Schneider Electric.
 5. TORK.
 6. Touch-Plate, Inc.
 7. Watt Stopper (The).
- B. Description: Solid state, with SPST dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.
 1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
 2. Time Delay: 30-second minimum, to prevent false operation.
 3. Lightning Arrester: Air-gap type.
 4. Mounting: Twist lock complying with IEEE C136.10, with base.

2.3 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hubbell Lighting.
 2. Leviton Mfg. Company Inc.
 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 4. Novitas, Inc.
 5. RAB Lighting, Inc.
 6. Sensor Switch, Inc.
 7. TORK.

8. Watt Stopper (The).
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
- C. Dual-Technology Type: Wall- or ceiling-mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit. Refer to drawings for type of detector to be used.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch high ceiling.

2.3 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allen-Bradley/Rockwell Automation.

2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 3. Eaton Electrical Inc.; Cutler-Hammer Products.
 4. GE Industrial Systems; Total Lighting Control.
 5. Grasslin Controls Corporation; a GE Industrial Systems Company.
 6. Hubbell Lighting.
 7. Lithonia Lighting; Acuity Lighting Group, Inc.
 8. MicroLite Lighting Control Systems.
 9. Square D; Schneider Electric.
 10. TORK.
 11. Touch-Plate, Inc.
 12. Watt Stopper (The).
 13. Siemens.
- B. Description: Electrically operated and mechanically or electrically held, as scheduled, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Enclosure: Comply with NEMA 250.
 3. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.
- C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.
1. Monitoring: On-off status.
 2. Control: On-off operation.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

- B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

*** END OF SECTION 26 09 23 ***

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SECTION 26 24 16 - PANELBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Electronic-grade panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
- C. Qualification Data: For qualified testing agency.
- D. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Field Quality-Control Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Panelboard Schedules: For installation in panelboards. Submit final versions after load Balancing.
- G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
 3. Provide a coordination study for the Level 1 Emergency System (if applicable). If there are any changes to the distribution system required for proper coordination, those costs shall be included in the Original Bid.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.
 - 3. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 6. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
 7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
1. Material: Hard drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
 5. Split Bus: Vertical buses divided into individual vertical sections.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Compression type.
 3. Ground Lugs and Bus-Configured Terminators: Compression type.
 4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 6. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.
- I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. For doors more than 36 inches high, provide two latches, keyed alike.
- E. Mains: Circuit breaker or Lugs only.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- H. Branch Overcurrent Protective Devices: Fused switches.

- I. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.
- J. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- K. Current Limiting Molded Case Circuit Breakers: NEMA AB 1 FS W-C-375; provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
- H. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as shown on Drawings. These ratings may be lowered by short circuit calculations performed by manufacturer stating actual A.I.C. ratings throughout entire system.

- I. Molded Case Circuit Breakers: FS W-C-375; bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on Drawings.
- J. Current Limiting Molded Case Circuit Breakers: FS W-C-375; provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I₂t response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - h. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."

2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
3. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- K. Comply with NECA 1.
- L. Install panelboards plumb [and flush with wall finishes], in conformance with NEMA PB 1.1.
- M. Height: 6 feet 6 inches.
- N. Provide filler plates for unused spaces in panelboards.
- O. Provide typed circuit directory for each branch circuit panelboard, new or existing. Revise directory to reflect circuiting changes required to balance phase loads. Trace out all circuits in existing panelboards to indicate an accurate directory per new space changes and room numbers.
- P. Stub 5 empty one inch conduits to accessible location above ceiling out of each recessed panelboard.
- Q. At a minimum, Contractor shall meggar test all feeder conductors larger than 300 kcm. Meggar testing shall be completed prior to terminating either end of the conductors, to certify that the conductor insulation integrity has not been damaged from handling and/or installation. Contractor shall meggar test the insulation resistance of each phase to phase, phase to neutral and phase to ground conductor for one minute each. Test voltage shall be 1000 volts, and minimum acceptable value for insulation resistance is 2 megohms. Provide written report of certification testing to Engineer, replace any damaged conductors as necessary prior to terminations.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

*** END OF SECTION 26 24 16 ***

SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Receptacles with integral surge suppression units.
 - 4. Wall-box motion sensors.
 - 5. Isolated-ground receptacles.
 - 6. Hospital-grade receptacles.
 - 7. Snap switches and wall-box dimmers.
 - 8. Solid-state fan speed controls.
 - 9. Wall-switch and exterior occupancy sensors.
 - 10. Pendant cord-connector devices.
 - 11. Cord and plug sets.
 - 12. Floor service outlets and multioutlet assemblies.
- B. Related Sections include the following:
 - 1. Division 26 Section "Raceways and Boxes for Electrical Systems."
 - 2. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.

- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- 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 NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 8300 (duplex).
 - b. Hubbell; HBL8310 (single), HBL8300H (duplex).
 - c. Leviton; 8310 (single), 8300 (duplex).
 - d. Pass & Seymour; 9301-HG (single), 9300-HG (duplex).
- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; CR 5253IG.
 - b. Leviton; 5362-IG.
 - c. Pass & Seymour; IG6300.
 - 3. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; TR8300.
 - b. Hubbell; HBL8300SG.
 - c. Leviton; 8300-SGG.
 - d. Pass & Seymour; 63H.
 - 3. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with UL 498 Supplement SD.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; HGF20.
 - b. Hubbell; HGF8300.
 - c. Leviton; 6898-HG.
 - d. Pass & Seymour; 2091-SHG.

2.4 TVSS RECEPTACLES

- A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.
 - 1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
 - 2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
- B. Duplex TVSS Convenience Receptacles:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5362BLS.
 - b. Hubbell; HBL5362SA.
 - c. Leviton; 5380.
 - 3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

- A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.
 - 1. 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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Crouse-Hinds.
 - b. EGS/Appleton Electric.
 - c. Killark; a division of Hubbell Inc.

2.6 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.

2.7 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
 - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.8 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Pilot Light Switches, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
 - 3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

- D. Key-Operated Switches, 120/277 V, 20 A:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
 3. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.
- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L.
 - b. Hubbell; HBL1557L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.

2.10 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 - 1. 1000 W; dimmers shall require no derating when ganged with other devices. Match load shown on drawings.
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.11 FAN SPEED CONTROLS

- A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
 - 1. Three-speed adjustable rotary knob, 1.5 A.

2.12 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth stainless steel.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.13 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type or flap-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular or round, solid brass with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray for data/communications outlets, ivory for convenience outlets, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Blank cover with bushed cable opening for four CAT 5 jacks.

2.14 MULTIOUTLET ASSEMBLIES

- 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. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold Company (The).
- C. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- D. Raceway Material: Metal, with manufacturer's standard finish.
- E. Wire: No. 12 AWG.

2.15 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Toggle Switches: White.
 - 2. Convenience Receptacles: White.
 - 3. GFCI Receptacles: White.
 - 4. TVSS Devices: Blue.
 - 5. Isolated-Ground Receptacles: Orange.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
 - 1. Install dimmers within terms of their listing.
 - 2. Verify that dimmers used for fan speed control are listed for that application.
 - 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

*** END OF SECTION 26 27 26 ***

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SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Molded-case switches.
 - 7. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Field quality-control reports.
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Manufacturer's field service report.
- F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 1000 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than fourteen (14) days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: One for each size and type.

PART 2 PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.

- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac for voltage applied, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 240 or 600-V ac for voltage applied, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 240 or 600-V ac for voltage applied, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open when specified with VFD mounted separately.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac for voltage applied, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- C. Type HD, Heavy Duty, Six Pole, Single Throw, 240 or 600-V ac for voltage applied, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 240 or 600-V ac for voltage applied, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open when specified with VFD mounted separately.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 RECEPTACLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 240 or 600-V ac for voltage applied, 30 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 240 or 600-V ac for voltage applied, 30 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

- E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).
 - 1. Receptacle Manufacturer and Catalog Number: NEMA type configuration as shown on drawings.

2.4 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Ferraz Shawmut, Inc.
 - 3. Littelfuse, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power of enough capacity to operate shunt trip, connected pilot, and indicating and control devices. Refer to drawings to ensure separate 120 V source not provided by other means.
- E. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight green ON pilot light.
 - 3. Isolated neutral lug; 100 percent rating.
 - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 5. Form C alarm contacts that change state when switch is tripped.
 - 6. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.5 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 1. Long- and short-time pickup levels.
 2. Long- and short-time time adjustments.
 3. Ground-fault pickup level, time delay, and I₂t response.
- E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- F. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- I. Features and Accessories:
 1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact when indicated on drawings.

2.6 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:
 - 1. Standard frame sizes and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.7 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 6. Mechanical Cooling Tower Areas: NEMA 250, Type 4X, stainless steel.
 - 7. Hazardous Areas Indicated on Drawings: NEMA 250, Type 9.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

*** END OF SECTION 26 28 16 ***

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SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.
 - 3. Reduced-voltage magnetic.
 - 4. Reduced-voltage solid state.
 - 5. Multispeed.
- B. Related Section:
 - 1. Division 26 Section "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - 3. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.
- F. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. 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 NFPA 70.

- D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 1000 feet.

1.8 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Indicating Lights: Two of each type and color installed.
 - 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Surface mounting.
 - 4. Green pilot light.
 - 5. Additional Nameplates: HIGH and LOW for two-speed switches.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 - 4. Surface mounting.

5. Green pilot light.
- D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 2. Configuration: Nonreversing.
 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
 4. Surface mounting.
 5. Green pilot light.
 6. Auxiliary contacts when specified. Coordinate normally open or normally closed with function.
- E. Magnetic Controllers: Full voltage, across the line, electrically held.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 2. Configuration: Nonreversing.
 3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: Minimum 100 VA.
 6. Bimetallic Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 10 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
 7. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - e. Analog communication module.
 8. External overload reset push button.
- F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.

2. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
4. Nonfusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
5. MCP Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
6. MCCB Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.2 REDUCED-VOLTAGE MAGNETIC CONTROLLERS

- A. General Requirements for Reduced-Voltage Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A; closed-transition; adjustable time delay on transition.

- B. Reduced-Voltage Magnetic Controllers: Reduced voltage, electrically held.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 2. Configuration:
 - a. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
 - b. Part-Winding Controller: Separate START and RUN contactors, field-selectable for 1/2- or 2/3-winding start mode, with either six- or nine-lead motors; with separate overload relays for starting and running sequences.
 - c. Autotransformer Reduced-Voltage Controller: Medium-duty service, with integral overtemperature protection; taps for starting at 50, 65, and 80 percent of line voltage; two START and one RUN contactors.
 3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: Minimum 100 VA.
 6. Bimetallic Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 10 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.

7. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - e. Analog communication module.
 8. External overload reset push button.
- C. Combination Reduced-Voltage Magnetic Controller: Factory-assembled combination of reduced-voltage magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 2. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
 3. MCP Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
 - d. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

4. MCCB Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.

2.3 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 1. Dry and Clean Indoor Locations: Type 1.
 2. Outdoor Locations: Type 3R.
 3. Kitchen Areas: Type 4X, stainless steel.
 4. Other Wet or Damp Indoor Locations: Type 4.
 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
 6. Mechanical Cooling Tower Areas: Type 4X, stainless steel.

2.4 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty type.
 - a. Push Buttons: Recessed types; maintained as indicated.
 - b. Pilot Lights: Incandescent types; colors as indicated; push to test.
 - c. Selector Switches: Rotary type.
 2. Elapsed Time Meters: Heavy duty with digital readout in hours; resettable.
- B. Reversible N.C./N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Cover gaskets for Type 1 enclosures.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch nominal-thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in each fusible-switch enclosed controller.
- E. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- F. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

- G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.
- D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.
- E. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

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SECTION 26 32 13 - ENGINE GENERATORS

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 SCOPE OF WORK

- A. The generator system shall be as follows:
 - 1. Electrical Contractor shall furnish and install the specified generator set, including weatherproof enclosure, automatic transfer switch and remote annunciator. The Generator Vendor shall off-load the generator on-site and install on a concrete pad provided by the General Contractor.
 - 2. The Electrical Contractor shall install the generator's remote annunciator and automatic transfer switch. Contractor shall provide all conduit, conductors, cabling, etc. for a complete installation of the generator system and make all final connections..
 - 3. The Generator Vendor shall engage a factory-authorized service representative for generator start-up. The Electrical Contractor shall correct any noted deficiencies.
 - 4. The Vendor shall also perform a full load test utilizing portable test bank for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal.
 - a. During test, record the following at 20 minute intervals:
 - (1) Kilowatts.
 - (2) Amperes.
 - (3) Voltage.
 - (4) Coolant temperature.
 - (5) Room temperature.
 - (6) Frequency.
 - (7) Oil pressure.
 - b. Test alarm and shutdown circuits by simulating conditions.
 - c. Submit written report of full load test to Owner.

B. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.

- 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. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
4. Wiring Diagrams: Power, signal, and control wiring.

- C. Qualification Data: For manufacturer.

- D. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.

6. Report of exhaust emissions showing compliance with applicable regulations.
 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For packaged engine generators 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. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than two (2) hours' normal travel time from Installer's place of business to Project site.
 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- E. 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.
- F. Comply with ASME B15.1.
- G. Comply with NFPA 37.
- H. Comply with NFPA 70.

- I. Comply with NFPA 99.
- J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- K. Comply with UL 2200.
- L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- M. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation. EPA certification to meet environmental requirements at time of commissioning.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than seven (7) days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 5 to 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two (2) years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
 - 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
 - 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- 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. Caterpillar; Engine Div.
 - 2. Kohler Co.; Generator Division.
 - 3. Onan/Cummins Power Generation; Industrial Business Group.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Genset and subbase fuel tank shall be trailer mounted, portable unit worthy of travel on public roadways.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated.
2. Output Connections: Three-phase, four wire, as sized on the drawings.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 15 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

- A. Fuel: Fuel oil, Grade DF-2 diesel.
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.
- D. Lubrication System: The following items are mounted on engine or skid:
 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. Cooling System: Closed loop, liquid cooled, with remote radiator and integral engine-driven coolant pump.
1. Configuration: Horizontal air discharge.
 2. Radiator Core Tubes: Aluminum.
 3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 5. Fan: Driven by multiple belts from engine shaft.
 6. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 7. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
- J. Muffler/Silencer: Critical type silencer, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 18 dB at 500 Hz.
 2. Sound level measured at a distance of 23 feet from exhaust discharge after installation is complete shall be 75 dBA or less.
- K. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- L. Starting System: 24-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
 7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank and Florida Department of Environmental Protection. Features include the following:
 1. Tank level indicator.
 2. Capacity: Refer to drawings.
 3. Vandal-resistant fill cap.
 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.
 5. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of day tank.
 - a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.
 6. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.

7. High-Level Alarm Sensor: Liquid-level device operates alarm and redundant fuel shutoff contacts at midpoint between overflow level and 100 percent of normal fuel level.
8. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 1. AC voltmeter.
 2. AC ammeter.
 3. AC frequency meter.
 4. DC voltmeter (alternator battery charging).
 5. Engine-coolant temperature gage.
 6. Engine lubricating-oil pressure gage.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.
 10. Start-stop switch.
 11. Overspeed shutdown device.
 12. Coolant high-temperature shutdown device.

13. Coolant low-level shutdown device.
 14. Oil low-pressure shutdown device.
 15. Generator overload.
- E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."
- G. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Overcrank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.
 6. Engine high-temperature shutdown.
 7. Lube-oil, low-pressure shutdown.
 8. Overspeed shutdown.
 9. Remote emergency-stop shutdown.
 10. Engine high-temperature prealarm.
 11. Lube-oil, low-pressure prealarm.
 12. Fuel tank, low-fuel level.
 13. Low coolant level.
- H. Remote Alarm Annunciator: Comply with NFPA 99 and NFPA 110 for Level 1 systems. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated. Generator alarm annunciator shall be located adjacent to the fire alarm remote annunciator.
- I. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
 - 1. Tripping Characteristic: Designed specifically for generator protection.
 - 2. Trip Rating: Matched to generator rating.
 - 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 - 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
 - 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 - 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 - 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
 - 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Dripproof.

- G. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point. Coordinate voltage and kilowatt rating with drawings.
- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- J. Subtransient Reactance: 12 percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 155 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
 - 1. Concrete Foundation: Coordinate with Division 03 Contractor.
 - 2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads of 155 mph.
 - 3. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
 - 4. Hinged Doors: With padlocking provisions.
 - 5. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
 - 6. Muffler Type/Location: Critical type silencer, located within enclosure.
- B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
- C. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
 - 1. AC lighting system and connection point for operation when remote source is available.
- D. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.9 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
 - 1. Material: Natural rubber.
 - 2. Durometer Rating: 50.

2.10 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.11 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Full load run.
 - 3. Maximum power.
 - 4. Voltage regulation.
 - 5. Transient and steady-state governing.
 - 6. Single-step load pickup.
 - 7. Safety shutdown.
 - 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
 - 9. Report factory test results within 10 days of completion of test.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Securely dock the trailer-mounted packaged engine generator at its concrete pad..
- D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
 - 1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
- E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 - 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 - 6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 - 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 - 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations within 50 feet of generator and compare measured levels with required values.
- D. Coordinate tests with tests for transfer switches and run them concurrently.
 - E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
 - F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - I. Remove and replace malfunctioning units and retest as specified above.
 - J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
 - K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
 - L. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

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SECTION 26 36 00 - TRANSFER SWITCHES

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 SCOPE OF WORK

- A. The automatic transfer switch shall be as follows:
 - 1. Electrical Contractor shall furnish and install the specified automatic transfer switch, including the associated generator, weatherproof enclosure, and remote annunciator.
 - 2. The Electrical Contractor shall install the generator's remote annunciator and automatic transfer switch. Contractor shall provide all conduit, conductors, cabling, etc. for a complete installation of the generator system and make all final connections..
 - 3. The Generator Vendor shall engage a factory-authorized service representative for generator start-up. The Electrical Contractor shall correct any noted deficiencies.
 - 4. The Vendor shall also perform a full load test utilizing portable test bank for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal.
 - a. During test, record the following at 20 minute intervals:
 - i. Kilowatts.
 - ii. Amperes.
 - iii. Voltage.
 - iv. Coolant temperature.
 - v. Room temperature.
 - vi. Frequency.
 - vii. Oil pressure.
 - b. Test alarm and shutdown circuits by simulating conditions.
 - c. Submit written report of full load test to Owner.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Qualification Data: For manufacturer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For each type of product 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. Features and operating sequences, both automatic and manual.
 - 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.
- D. 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.
- E. Comply with NEMA ICS 1.
- F. Comply with NFPA 70.
- G. Comply with NFPA 99.

- H. Comply with NFPA 110.
- I. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 - 1. Notify Owner no fewer than seven (7) days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 WARRANTY

- A. Provide one year manufacturer's warranty under provisions of Division 1.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- 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. Contactor Transfer Switches:
 - a. AC Data Systems, Inc.
 - b. Caterpillar; Engine Div.
 - c. Emerson; ASCO Power Technologies, LP.
 - d. GE Zenith Controls.
 - e. Kohler Power Systems; Generator Division.
 - f. Onan/Cummins Power Generation; Industrial Business Group.
 - g. Russelectric, Inc.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- C. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- D. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- E. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switch Action: Double throw; mechanically held in both directions.
 - 2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- F. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- G. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- H. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- I. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency

difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

D. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal-and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Wall Mounted: Secure firmly to wall according to Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
 1. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 4 inches in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Identify components according to Division 26 Section "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
 - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 - 5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- D. Coordinate tests with tests of generator and run them concurrently.
- E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- F. Remove and replace malfunctioning units and retest as specified above.
- G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."
- B. Coordinate this training with that for generator equipment.

*** END OF SECTION 26 36 00 ***

SECTION 26 37 00 – ABOVE GROUND STORAGE TANK EQUIPMENT (DIESEL)

PART 1 GENERAL

1.0 INTENT

- A. It is the Intent that this Section of the specifications shall be a criteria basis for a turnkey fuel oil Above Ground Storage Tank Equipment.
- B. Provide the following system functions:
 - 1. Storage tank to be connected to:
 - a. Diesel fueling station remote pump mounted on side of storage tank.
 - b. Veeder Root tank level monitoring device (provided by Electrical Contractor).
 - c. Fuel Master tank management and inventory control device (provided by Electrical Contractor).
 - 2. Coordinate piping path from the storage tank to the supply and return fuel connection for generator (piping provided by Division 23).
 - 3. Provide and install all equipment, controls, fittings, wiring and accessories for a complete fuel storage system to support connection to generator.
 - 4. Coordinate piping path from storage tank to fueling station (piping provided by Division 23).
- C. Wherein specific equipment manufacturers or products are listed in this Section, it is for reference and to establish functional performance standards only. Other equipment, manufacturers and products may be used provided the Engineer concurs the minimum functional criteria listed below are met.
- D. Functional Criteria:
 - 1. All devices shall be removable for maintenance, replacement and repair.

1.1 WORK SECTION INCLUDES

- A. Types of fuel storage equipment required include, but are not limited to:
 - 1. Double wall above ground fuel storage tank and accessories.
 - 2. Electrical work.
 - 3. Fuel dispensers.

1.2 RELATED WORK

- A. Drawing and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Although such work is not specifically shown or specified all appurtenances and devices incidental to or necessary for a sound, secure, safe and complete installation shall be furnished and installed as a part of this work.

1.3 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the current provisions of all codes Federal, State, County and City related to work being accomplished and following codes, specifications and standards except where more stringent requirements are shown or specified.
 - 1. Underwriters Laboratories (UL) codes.
 - 2. National Fire Protection Agency (NFPA) codes.
 - 3. National Electric (NEC) codes.
 - 4. Environmental Protection Agency (EPA) codes.
 - 5. Department of Environmental Regulation (DER) codes.
 - 6. OSHA codes and guidelines.
 - 7. Manufacturer's installation and operational guidelines.
- B. Current National Fire Protection Agency, "Standard for the Installation of Oil Burning Equipment", NFPA 31 (ANSI Z95.1) and the "Flammable and Combustible Liquids Code, NFPA 30, FDER 17-761.
- C. Current Petroleum Equipment Institute, "Recommended Practices for Installation of Underground Liquid Storage Systems", PEI/RP100.
- D. Installer Qualifications: A Specialty Contractor with minimum of 6 years experience in performing installation and servicing of above ground fuel tanks.
- E. Requirements of Regulatory Agency: All work shall conform to the applicable requirement of the Federal, State, County and City codes and NFPA 30. The monitoring system shall conform to the requirements of Florida Statute 376-303, Chapter 17-761, Stationary Tanks. All components shall be UL listed. If in any part of the plans and specifications conflict with the above codes, it shall be the responsibility of the Contractor to notify the Architect-Engineer before contract has been negotiated, it shall be the responsibility of the Contractor to conform with the above codes at no additional expense to the Owner and shall advise the Architect-Engineer before making any changes.

1.4 SUBMITTALS

- A. General: All submittals shall follow guidelines as specified in Section 15010, Basic Mechanical Requirements, and Section 16010, Basic Electrical Requirements.

- B. Product Data: Prior to placing any work, submit manufacturer's product data, specifications, installation and maintenance instructions and wiring diagrams for each type of equipment required to the Architect-Engineer. Submittals shall be in accordance with Section 16010 and shall include:
1. Equipment
 2. Electrical wiring
 3. Electrical devices
 4. Electrical specialties
 5. All items listed herein
- Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.
- C. Operation and Maintenance Manuals: Provide complete parts, operating, and maintenance manual covering equipment at time of installation including, but not limited to:
1. Description of system and components.
 2. Schematic diagrams of electrical, hydraulic, and mechanical systems.
 3. Manufacturer's printed operating instructions.
 4. Printed listing of periodic preventative maintenance items and recommended frequency required to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.
 5. List of original manufacturer's parts, including suppliers' part numbers and cuts, recommended spare parts stockage quantity and local parts and service source.
 6. Assemble and provide copies of manual 8 1/2 by 11 inch format. Foldout diagrams and illustrations are acceptable. Manual to be reproducible by photocopy method. Provide copies per provisions of Division I - General Requirements.
- D. Shop Drawings: Provide and submit shop drawings and details for electrical wiring and equipment installation as required for this project.
- E. Certificates: Dated certificates of inspection and system approval by all local, city, county, state, and federal governing authorities shall be delivered in triplicate to the Architect-Engineer prior to final acceptance of the work. The Contractor shall obtain written certification from all manufacturers that installer is approved by manufacturer for installation of specific system.
- F. The Specialty Contractor shall provide primary products including tools and accessories necessary to perform the special work and/or approved by a single manufacturer.
- G. The manufacturer determines the distributors or supplies of this product and directly or indirectly has responsibility for selecting the method of transport and of storage, therefore, the manufacturer must be considered fully responsible for materials until such are delivered into the hands and control of the Contractor or Subcontractors.

- H. Templates: The Contractor shall provide and submit templates for anchor bolts and other items set in concrete.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Division 1, General Requirements, and products/handling/delivery/storage shall conform to the minimum recommendations of the manufacturers of the products herein specified.

1.6 ERRORS AND OMISSIONS

- A. If, due to an error or omission in the scope of work, a particular item is not specifically included but is necessary to provide the Owner with a fully functional fueling facility, then that item is considered to be included in the scope of work just as if it had been listed in detail herein.

1.7 PRODUCT SUBSTITUTIONS

- A. Follow requirements specified in Division 1, General Requirements.
- B. Additional costs resulting from substitution of products other than those specified, including drawing changes and construction, will be at the expense of the Contractor.
- C. Substitution Approval: Manufacturer's listed for each equipment item may bid without submittal for that item. Manufacturers not listed shall submit for approval in accordance with "Instructions to Bidders". Prior to installation, submittals for each equipment items by Mark Number shall be provided in accordance with Division 1, General Requirements.

PART 2 PRODUCTS

2.1 RECTANGULAR ABOVE GROUND FUEL STORAGE TANK

- A. General: The Contractor shall furnish and install diesel, above ground, UL labeled, dual wall storage tank as shown on the drawings. Configuration of tank shall comply with available concrete pad footprint.

Tank shall be supplied with the following integral features:

1. Tank shall be fabricated per UL-142 of mild carbon steel with shell seams of continuous lap weld construction.
2. Tank shall be of double wall construction and provide complete secondary containment of the primary storage tank's contents by an impervious steel outer wall.
3. A minimum of 3" porous, lightweight monolithic thermal insulation material shall be installed at the factory within the interstitial space between the inner and outer wall. Thermal insulation material:
 - a. Shall be in accordance with ASTM Standards C-332 & C-495
 - b. Shall allow liquid to migrate through it to the monitoring point

- c. Shall not be exposed to weathering and shall be protected by the steel secondary containment outer wall
- 4. Lifting lugs shall be provided at balancing points to facilitate handling and installation.
- 5. Exterior Protective Coating:
 - a. Surface Preparation: grit blast – SSPC-SP-6 White Blast
 - b. Finish: White finish paint system 5-7 DFT on the shell and heads
- 6. Threaded fittings with thread protectors shall be supplied as follows (all fittings must be located on tank top per UL):
 - a. One (1) 2" – Interstitial Monitoring
 - b. One (1) 2" – Normal Vent, Primary Tank
 - c. One (1) 6" – Emergency Vent, Primary Tank
 - d. One (1) 6" – Emergency Vent, Secondary Tank
 - e. One (1) 2" – Product Pump or Supply
 - f. One (1) 2" – Liquid Level Gauge
 - g. One (1) 2" – Manual Gauge Port (without drop tube and striker plate).
 - h. One (1) 2" – Sump port with 1" drop tube with anti-vortex slots, extending down to bottom of tank. Sump port shall be located near the end of the tank.
- 7. Accessories:
 - a. UL listed Spill/Overfill Container – 5-15 gallon (minimum). Bottom fill capable with EPC approved fill box with a dry break, 3" male coupler.
 - b. Pump Mount(s) for Top Mount or for Free Standing Pumps and Dispensers on Standard or Split Tanks.
 - c. "Spill-Mate" for remote fill mounted to side of tank. Equip with hand pump to return spilled fuel back to the tank via a spin on coalescing filter.
 - d. Working platform and access stairs with flat, anti-skid rungs to access gauging hatch.
 - e. Standard diesel package
 - f. Retractable hose reel with 25-foot hose length.
 - g. OPW 200 sight gauge.
 - h. Hand operated sump pump.

8. No steel or insulating material shall come in contact with the concrete or other corrosive material.
 9. All openings shall be from the top only.
 10. All exposed metal must be powder coated to inhibit corrosion.
 11. The UL listed spill containment shall include a normally closed valve to release spilled product into the primary steel tank. Spill containments that route spilled product into the interstitial area will not be approved.
 12. The protected and insulated AST systems shall have two (2) lugs for connecting grounding conductors for lightning protection in accordance with NFPA780.
 13. Pre-engineered steel supports (solid channel or I-beam supports).
 14. Suction pipe and sump for dewatering the secondary containment.
 15. Tank manway cover (bolted) and manhole 22" diameter minimum.
- B. Contractor shall submit five (5) copies of shop drawings for each tank showing locations of all fittings, accessories and critical dimensions. Also submit five (5) copies of current manufacturer's literature and complete current installation instructions.
- C. Products: Tanks shall be manufactured by Fireguard, Modern Welding Company of Florida or approved equal.
- D. Certification Plate: UL labels for petroleum products shall be affixed to each tank.
- E. The Contractor shall provide and assist Owner with the completion of all forms which may be required for the installation or removal of the tanks.
- F. Tank Testing:
1. Upon receipt of the tanks, the Contractor shall test the tanks using 5 psi air pressure and shall soap all seams and bung holes to assure tightness.
- G. Tank Warranty: Tanks shall be warranted as follows:
1. Will be free from material defects in materials and workmanship for a period of one (1) year following date of building Substantial Completion.
 2. Will not fail for a period of thirty (30) years from date of Substantial Completion due to external corrosion; and
 3. Will not fail for a period of thirty (30) years from date of Substantial Completion due to internal corrosion provided tank is used solely with or without tank water bottoms for the following procedures:
 - a. Petroleum products including gasoline, jet fuel, av-gas, motor oil (new or used), kerosene, diesel fuel, or used for fuel oil at temperatures not to exceed 150 F.
 4. Will not leak for a period of thirty (30) years from date of Substantial Completion due to structural failure, which shall be defined as breaking or collapse.

H. Design Loading Conditions

All tanks shall meet the following design criteria:

1. Primary Tank: Tank to withstand internal air pressure of 5 psi without leakage and to include a 5:1 safety factor. The manufacturer shall test every tank at 9. inches mercury vacuum to assure structural integrity.
 2. Secondary Tank: Tank to withstand internal air pressure of 5 psi without leakage and to include a 5:1 safety factor.
 3. Accessory Equipment Loads: Tank shall withstand loads imposed by drop tubes, submersible pump, piping, and related tank mounted items without damage.
- I. Product Storage: All primary tanks must be vented. Tanks are designed for operation at atmospheric pressure only, except for use with vapor recovery system at a pressure or vacuum of approximately 1 psi. Tanks shall be capable of storing liquids with a maximum specific gravity of 1.1 and a maintained temperature of 150 F maximum at tank interior surface. Tanks shall be chemically inert to petroleum products.
- J. Tank Dimensions and Capacity
1. Capacity: 2,000 gallon UL-2085 Fireguard® Thermally Insulated, Double-Wall Steel Aboveground Storage Tank.
 2. Tank Outer Dimensions (L x W x H): 11'-3" x 6'-10" x 4'-7". Dimensions and device access shall allow for removal of devices in the area provided.
 3. The tank dimensions shown do not include accessories items, including but not limited to, access platforms, fuel dispensers, remote fill box, hand pumps, etc. Contractor shall coordinate overall system footprint and required clearances with the intended installation location.

2.2 OVERFILL PROTECTION DEVICE

- A. Specialty Contractor to furnish and install fill device with overfill protection device with cap.
Supply 4" fill riser pipe.

2.3 FILL LINE AND VENT LINE OVERSPILL PROTECTION DEVICE

- A. Specialty Contractor to furnish and install an above ground remote trunk unloading connection and spill container.
- B. Locate outside with closing/locking cover. Provide check valve, ball valve, and dry break quick connect.

2.4 DIESEL TANK VENT CAP

- A. Specialty Contractor to furnish and install, UL listed and NFPA Code 30, vent cap on each diesel tank vapor vent line.

2.5 TANK LEVEL MODULE

- A. The module shall have three standard alarm indications:
1. High Fuel—activates at 90% of normal fuel level.
 2. Low Fuel—activates at 25% of normal fuel level.
 3. Leak Detection—activates when fuel is detected in the interstice tank via float switch.

2.6 ANTI-SIPHONING VALVES

- A. Contractor to furnish and install UL listed anti-siphoning valves at each fuel dispensing unit location capable of shutting off flow of fuel in event of fire or severe impact.

2.7 REMOTE FUEL DISPENSER SYSTEM

- A. Contractor to furnish and install one UL listed, pump and meter fueling station as manufactured by Great Plains Industries, or approved equal. Dispenser shall be lockable. Mount dispenser approximately 4.5 to 5 feet above finished slab elevation. Mount dispenser on side of tank that is adjacent to the driveway or fueling area.

1. Remote Dispenser: Provide GPI MR-530 Remote Dispenser with non-computer with automatic reset. Non-computer, mechanical meter with four wheel, four digit transaction display. Meter shall indicate gallons and tenths. Fuel Dispenser shall be 115V.

Totals per Transaction: Up to 999.9 gallons.

Totalizer: Up to 999,999.9 gallons.

2. Hose: UL Listed 1" diameter, 25' long , Buna-N, statically grounded hose manufactured by Great Plains Industries, or approved equal.
3. Pump: Provide UL Listed remote pump M-3120-RDP manufactured by GPI, or equal. Pump shall be capable of supplying 20 gpm and shall be 115V.
4. Fuel Dispensing Nozzle: Provide heavy duty, shock proof, automatic, self-closing diesel fuel dispensing nozzle capable of supplying 32 gpm. The nozzle shall be manufactured by GPI, or approved equal.
5. Electrical Interface:
 - a. Contractor to furnish and install rigid conduit, power wiring, junction boxes, panels and seal-offs as required for proper unit operation.
 - b. Contractor to furnish and install all control wiring, secure seal-offs and terminate dispensers per manufacturer's specifications.
6. Accessories:
 - a. Provide pulse out device for interface with Fuel Master System.
 - b. Provide shelf kit for mounting pump on the front of the aboveground tank.

- c. Provide fuel dispensing filter.
- d. Provide retractable hose reel capable of handling 25 feet of hose.

2.8 LIQUID LEVEL SITE GAUGE

- A. Specialty Contractor to furnish and install, UL listed and NFPA Code 30, OPW 200 mechanical liquid level site gauge. Angle gauge toward fill box.

2.9 FUEL MANAGEMENT AND INVENTORY CONTROL

- A. Each fuel tank used to dispense fuel to vehicles or equipment shall be controlled by a FuelMaster 3508 system with dual AIM 2 and 2.4 capabilities. The fuel management system shall be equipped with a Veeder Root TLS4c tank gauging system. Both systems shall have network connectivity for remote monitoring.
- B. The Specialty Contractor shall make final connections, program and test the FuelMaster and Veederroot systems. Coordinate monitoring requirements with Owner prior to installation.

2.10 ELECTRICAL

- A. General: Contractor shall provide electrical work related to storage tanks, pumps, fuel dispensing units, monitoring systems and other fuel storage or dispensing systems as work of this section.
- B. Master Emergency Disconnect Switches: Contractor to furnish and install master emergency disconnect. Locate disconnect in accordance with local code requirements.
- C. Contractor to terminate the connection of the emergency disconnect switches to pump contactor and to all fuel dispenser switches so that activation of either emergency switch will interrupt all power to pumps and fuel dispensers at one time.
- D. Contractor to terminate connection of the pump contactor between master emergency disconnect switches and pump.

PART 3 EXECUTION

3.1 TANK PREPARATION

- A. Discrepancies: Do not proceed with work, until all unsatisfactory conditions affecting scheduled work have been corrected to the satisfaction of the Electrical and Specialty Contractor and manufacturer of tanks.

3.2 TANK INSTALLATION

- A. General: Tanks shall be tested and installed in full accordance with current installation instructions published by tank manufacturer. (These instructions must accompany tanks.)
- B. Handling of tanks shall be in full compliance with manufacturer's methods and procedures.
- C. Anchoring: Follow submitted design by a Florida Registered Structural Engineer.

- D. Tank shall be installed on a concrete pad, which provides a slight slope towards the end of the tank where the sump pump will be installed.
- E. Furnish and install one 3" diameter coaxial fill connections with OPW—overfill prevention valves.
- F. Furnish and install venting and product lines as shown on drawings.
- G. Contractor shall hand paint all threaded connections after installation to insure no bare steel is exposed to the elements.

3.3 PREPARATION AND INSTALLATION OF PIPING

- A. All Contractors shall follow current manufacturer's installation practices.
- B. Vent Piping: Specialty Contractor shall install vertical vent piping. Install proper vent caps.
- C. Electrical Contractor to install all rigid conduit, power wiring, wiring devices, controls panels, switches, emergency switches, disconnects, seal-offs, and other electrical items as required for a complete, operational system. All electrical services to the tanks shall be Class I, Division I, explosion proof.
- D. Control Wiring: Specialty Contractor to furnish and install all control wiring, secure seal-offs and terminate all control panels, sensors and probes.

3.4 TANK LEAK DETECTION DEVICE TEST

- A. Prior to final acceptance, the Specialty Contractor shall perform a leak detector test to ensure the proper functioning of the leak detector.
 - 1. The leak detection performance of the monitoring system shall be tested and verified by a qualified independent consultant to detect leaks as small as 0.5 gallons per hour with a 95% probability of detection and less than a 5% probability of a false alarm.
 - 2. Specialty Contractor shall have a precision hydrostatic test, PetroTite or equivalent testing as permitted by the local Health Department, performed on tanks and piping at the completion of the installation.

3.5 MISCELLANEOUS EQUIPMENT INSTALLATION/CLEAN-UP/TRAINING

- A. Contractor shall install reinforced concrete apron of size, thickness, and reinforcing shown or required. Slope away from storage tank manholes and access boxes for drainage. Finish to smooth finish.
- B. Testing: As work progress, perform testing of components and systems to verify compliance. Perform tests in presence of Owner and Architect/Engineer. Perform tests on subsurface and concealed items prior to backfilling and cover-up.
- C. Contractor shall perform operational tests on entire fuel dispensing system when work is completed and at time of Substantial Completion.
- D. Instructions to Owner's Personnel: Contractor shall instruct Owner's personnel in the proper operation and maintenance of fuel dispensing equipment.

- E. Operational and Maintenance Manuals: Contractor shall provide properly bound and labeled fuel dispensing equipment operation and maintenance manuals. Comply with Division 1 requirements.
- F. Clean-Up and Adjust: Contractor shall remove all debris, sweep broom clean, and wipe clean to remove dirt, oil, and grease. Adjust all equipment for proper operation.

*** END OF SECTION 26 37 00 ***

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SECTION 26 38 00 – ABOVE GROUND STORAGE TANK EQUIPMENT (UNLEADED)

PART 1 GENERAL

1.0 GENERAL

- A. It is the Intent that this Section of the specifications shall be a criteria basis for a turnkey fuel oil Above Ground Storage Tank Equipment.
- B. Provide and install a 300 gallon UL-2085 Fireguard® Thermally Insulated, FG Double-Wall Steel Aboveground Storage Tank. Tank storage volume shall be 300 gallons. Tank shall be 3' 2" in diameter x 5' 0" long. Approximate weight shall be 1,874 (lb.).
- C. The tank shall be designed for aboveground storage of flammable and combustible liquids at atmospheric pressure. Tank shall include integral steel secondary containment and thermal insulation that provides a minimum two-hour fire rating.
- D. Each tank shall be delivered as a complete UL-listed assembly with two factory supplied, welded-on saddles. Size and location of saddles shall be as required by Highland Tank. Saddles to be set level on a solid foundation.
- E. Tank shall be designed for possible relocation at a future date. Concrete encased tank designs are not equal and are required to be approved prior to bid by the Engineer.
- F. Tank shall comply with the latest edition of National Fire Protection Association NFPA 30 Flammable and Combustible Liquids Code. The tank's secondary containment must be tested for tightness in the factory and in the field before commissioning. Tank shall be supplied with emergency vents for the primary and the secondary containment tanks. Emergency venting by "form of construction" is not equal and will NOT be permitted.
- G. Inner and Outer Tank shall be manufactured in accordance with UL-142 Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids. Entire tank shall be labeled for Underwriters Laboratories UL 2085 Standard for Insulated Secondary Containment Aboveground Tank for Flammable Liquids. The tank design shall comply with UL 2085 "Protected" Tank standard and shall be tested for Ballistics, Impact, Hose Stream, and Pool Fire UL-2085 performance standards.
- H. Tank shall be manufactured and labeled in strict accordance with Steel Tank Institute (STI) Fireguard® Thermally Insulated, Double Wall Steel Aboveground Storage Tank standards as applied by a licensee of the STI. Tank shall be subject to the STI's Quality Assurance program and shall be backed by the STI 30 year limited warranty.

1.1 WORK SECTION INCLUDES

- A. Types of fuel storage equipment required include, but are not limited to:
 - 1. Double wall steel above ground fuel storage tank and accessories.
 - 2. Electrical work.
 - 3. Fuel pumps.

4. Fuel dispensers.

1.2 RELATED WORK

- A. Drawing and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Although such work is not specifically shown or specified all appurtenances and devices incidental to or necessary for a sound, secure, safe and complete installation shall be furnished and installed as a part of this work.

1.3 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the current provisions of all codes Federal, State, County and City related to work being accomplished and following codes, specifications and standards except where more stringent requirements are shown or specified.
 1. Underwriters Laboratories (UL) codes.
 2. National Fire Protection Agency (NFPA) codes.
 3. National Electric (NEC) codes.
 4. Environmental Protection Agency (EPA) codes.
 5. Department of Environmental Regulation (DER) codes.
 6. OSHA codes and guidelines.
 7. Manufacturer's installation and operational guidelines.
- B. Installer Qualifications: A Specialty Contractor with minimum of 6 years experience in performing installation and servicing of above ground fuel tanks.
- C. Requirements of Regulatory Agency: All work shall conform to the applicable requirement of the Federal, State, County and City codes and NFPA 30. The monitoring system shall conform to the requirements of Florida Statute 376-303, Chapter 17-761, Stationary Tanks. All components shall be UL listed. If in any part of the plans and specifications conflict with the above codes, it shall be the responsibility of the Contractor to notify the Architect-Engineer before contract has been negotiated, it shall be the responsibility of the Contractor to conform with the above codes at no additional expense to the Owner and shall advise the Architect-Engineer before making any changes.

1.4 SUBMITTALS

- A. General: All submittals shall follow guidelines as specified in Section 15010, Basic Mechanical Requirements, and Section 16010, Basic Electrical Requirements.
- B. Product Data: Prior to placing any work, submit manufacturer's product data, specifications, installation and maintenance instructions and wiring diagrams for each type of equipment required to the Architect-Engineer. Submittals shall be in accordance with Section 16010 and shall include:
 1. Equipment

2. Electrical wiring
3. Electrical devices
4. Electrical specialties
5. All items listed herein

Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.

- C. Operation and Maintenance Manuals: Provide complete parts, operating, and maintenance manual covering equipment at time of installation including, but not limited to:
1. Description of system and components.
 2. Schematic diagrams of electrical, hydraulic, and mechanical systems.
 3. Manufacturer's printed operating instructions.
 4. Printed listing of periodic preventative maintenance items and recommended frequency required to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.
 5. List of original manufacturer's parts, including suppliers' part numbers and cuts, recommended spare parts stockage quantity and local parts and service source.
 6. Assemble and provide copies of manual 8 1/2 by 11 inch format. Foldout diagrams and illustrations are acceptable. Manual to be reproducible by photocopy method. Provide copies per provisions of Division I - General Requirements.
- D. Shop Drawings: Provide and submit shop drawings and details for electrical wiring and equipment installation as required for this project.
- E. Certificates: Dated certificates of inspection and system approval by all local, city, county, state, and federal governing authorities shall be delivered in triplicate to the Architect-Engineer prior to final acceptance of the work. The Contractor shall obtain written certification from all manufacturers that installer is approved by manufacturer for installation of specific system.
- F. The Specialty Contractor shall provide primary products including tools and accessories necessary to perform the special work and/or approved by a single manufacturer.
- G. The manufacturer determines the distributors or supplies of this product and directly or indirectly has responsibility for selecting the method of transport and of storage, therefore, the manufacturer must be considered fully responsible for materials until such are delivered into the hands and control of the Contractor or Subcontractors.
- H. Templates: The Contractor shall provide and submit templates for anchor bolts and other items set in concrete.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Division 1, General Requirements, and products/handling/delivery/storage shall conform to the minimum recommendations of the manufacturers of the products herein specified.

1.6 ERRORS AND OMISSIONS

- A. If, due to an error or omission in the scope of work, a particular item is not specifically included but is necessary to provide the Owner with a fully functional fueling facility, then that item is considered to be included in the scope of work just as if it had been listed in detail herein.

1.7 PRODUCT SUBSTITUTIONS

- A. Follow requirements specified in Division 1, General Requirements.
- B. Additional costs resulting from substitution of products other than those specified, including drawing changes and construction, will be at the expense of the Contractor.
- C. Substitution Approval: Manufacturer's listed for each equipment item may bid without submittal for that item. Manufacturers not listed shall submit for approval in accordance with "Instructions to Bidders". Prior to installation, submittals for each equipment items by Mark Number shall be provided in accordance with Division 1, General Requirements.

PART 2 PRODUCTS

2.1 CYLINDRICAL ABOVE GROUND FUEL STORAGE TANK

- A. Construction
 - 1. Tank shall be fabricated per UL-142 of mild carbon steel with shell seams of continuous lap weld construction.
 - 2. Tank shall be of double wall construction and provide complete secondary containment of the primary storage tank's contents by an impervious steel outer wall.
 - 3. A minimum of 3" of porous, lightweight monolithic thermal insulation material shall be installed at the factory within the interstitial space between the inner and outer wall. Thermal insulating material:
 - a. Shall be in accordance with American Society of Testing Materials (ASTM) Standards C-332 and C-495.
 - b. Shall allow liquid to migrate through it to the monitoring point.
 - c. Shall not be exposed to weathering and shall be protected by the steel secondary containment outer wall.
 - 4. Lifting lugs shall be provided at balancing points to facilitate handling and installation.

5. Exterior Protective Coating:
 - a. Surface Preparation: Grit blast - SSPC-SP-6 White Blast.
 - b. Finish: White finish paint system 5-7 DFT on the shell and heads.
6. Threaded fittings with thread protectors shall be supplied as follows (all fittings must be located on tank top per UL):
 - a. One (1) 2" – Interstitial Monitoring
 - b. One (1) 2" – Normal Vent, Primary Tank
 - c. One (1) 4" – Emergency Vent, Primary Tank
 - d. One (1) 4" – Emergency Vent, Secondary Tank
 - e. One (1) 2" – Product Fill
 - f. One (1) 2" – Product Pump or Supply
 - g. One (1) 2" – Liquid Level Gauge
 - h. One (1) 2" – Manual Gauge Port (without drop tube and striker plate).
 - i. One (1) 2" – Sump port with 1" drop tube with anti-vortex slots, extending down to bottom of tank. Sump port shall be located near the end of the tank.
7. Accessories:
 - a. UL listed Spill/Overfill Container – 5-15 gallon (minimum). Top fill capable with EPC approved fill box with a dry break, 2" male coupler.
 - b. Pump Mount(s) for Top Mount or for Free Standing Pumps and Dispensers on Standard or Split Tanks.
 - c. Working platform and access stairs with flat, anti-skid rungs to access gauging hatch.
 - d. Standard gasoline package
8. No steel or insulating material shall come in contact with the concrete or other corrosive material.
9. All openings shall be from the top only.
10. All exposed metal must be powder coated to inhibit corrosion.
11. The UL listed spill containment shall include a normally closed valve to release spilled product into the primary steel tank. Spill containments that route spilled product into the interstitial area will not be approved.
12. The protected and insulated AST systems shall have two (2) lugs for connecting grounding conductors for lightning protection in accordance with NFPA780.

13. Pre-engineered steel supports (solid channel or I-beam supports).
14. Suction pipe and sump for dewatering the secondary containment.
- B. Contractor shall submit five (5) copies of shop drawings for each tank showing locations of all fittings, accessories and critical dimensions. Also submit five (5) copies of current manufacturer's literature and complete current installation instructions.
- C. Products: Tanks shall be manufactured by Fireguard, Modern Welding Company of Florida or approved equal.
- D. Certification Plate: UL labels for petroleum products shall be affixed to each tank.
- E. The Contractor shall provide and assist Owner with the completion of all forms which may be required for the installation or removal of the tanks.
- F. Tank Testing:
 1. Upon receipt of the tanks, the Contractor shall test the tanks using 5 psi air pressure and shall soap all seams and bung holes to assure tightness.

2.2 FUEL DISPENSER SYSTEM

- A. Contractor to furnish and install one UL listed fueling station as manufactured by Fill-rite, or approved equal, model FR610G. System shall be suitable for outdoor applications. Dispenser shall be lockable. Mount dispenser on side of tank that is adjacent to the driveway or fueling area.
- B. System shall include
 1. UL Listed 3/4" diameter, 15' long, Buna-N statically grounded hose
 2. Manual farm-style nozzle capable of supplying 15 GPM of unleaded fuel
 3. UL Listed 115 V motor.
- C. Electrical Interface:
 1. Contractor to furnish and install rigid conduit, power wiring, junction boxes, panels and seal-offs as required for proper unit operation.
 2. Contractor to furnish and install all control wiring, secure seal-offs and terminate dispensers per manufacturer's specifications.
- D. Accessories:
 1. Provide rigid fuel piping for all exposed connections. Refer to Fuel Piping specifications.
 2. Provide wall mount bracket for mounting system on the front of the aboveground tank.
 3. Provide fuel dispensing filter package.

2.3 LIQUID LEVEL SITE GAUGE

- A. Specialty Contractor to furnish and install, UL listed and NFPA Code 30, OPW 200 mechanical liquid level site gauge. Angle gauge toward fill box.

2.4 FUEL MANAGEMENT AND INVENTORY CONTROL

- A. Each fuel tank used to dispense fuel to vehicles or equipment shall be equipped with a Veeder Root TLS4c tank gauging system. The system shall have network connectivity for remote monitoring.
- B. The Specialty Contractor shall make final connections, program and test the Veeder Root system. Coordinate monitoring requirements with Owner prior to installation.

2.5 ELECTRICAL

- A. General: Contractor shall provide electrical work related to storage tanks, pumps, fuel dispensing units, monitoring systems and other fuel storage or dispensing systems as work of this section.
- B. Master Emergency Disconnect Switches: Contractor to furnish and install master emergency disconnect.
- C. Contractor to terminate the connection of the emergency disconnect switches to pump contactor and to all fuel dispenser switches so that activation of either emergency switch will interrupt all power to pumps and fuel dispensers at one time.
- D. Contractor to terminate connection of the pump contactor between master emergency disconnect switches and pump.

PART 3 EXECUTION

3.1 TANK PREPARATION

- A. Discrepancies: Do not proceed with work, until all unsatisfactory conditions affecting scheduled work have been corrected to the satisfaction of the Electrical and Specialty Contractor and manufacturer of tanks.

3.2 TANK INSTALLATION

- A. General: Tanks shall be tested and installed in full accordance with current installation instructions published by tank manufacturer. (These instructions must accompany tanks.)
- B. Handling of tanks shall be in full compliance with manufacturer's methods and procedures.
- C. Anchoring: Follow submitted design by a Florida Registered Structural Engineer.
- D. Furnish and install three 4" diameter coaxial fill connections with OPW—overfill prevention valves.
- E. Furnish and install venting and product lines as shown on drawings.

- F. Contractor shall hand paint all threaded connections after installation to insure no bare steel is exposed to the elements.

3.3 PREPARATION AND INSTALLATION OF PIPING

- A. All Contractors shall follow current manufacturer's installation practices.
- B. Vent Piping: Specialty Contractor shall install vertical vent piping. Install proper vent caps.
- C. Electrical Contractor to install all rigid conduit, power wiring, wiring devices, controls panels, switches, emergency switches, disconnects, seal-offs, and other electrical items as required for a complete, operational system. All electrical services to the tanks shall be Class I, Division I, explosion proof.
- D. Control Wiring: Specialty Contractor to furnish and install all control wiring, secure seal-offs and terminate all control panels, sensors and probes.

3.4 TANK LEAK DETECTION DEVICE TEST

- A. Prior to final acceptance, the Specialty Contractor shall perform a leak detector test to ensure the proper functioning of the leak detector.
 - 1. The leak detection performance of the monitoring system shall be tested and verified by a qualified independent consultant to detect leaks as small as 0.5 gallons per hour with a 95% probability of detection and less than a 5% probability of a false alarm.
 - 2. Specialty Contractor shall have a precision hydrostatic test, PetroTite or equivalent testing as permitted by the local Health Department, performed on tanks and piping at the completion of the installation.

3.5 MISCELLANEOUS EQUIPMENT INSTALLATION/CLEAN-UP/TRAINING

- A. Contractor shall install reinforced concrete apron of size, thickness, and reinforcing shown or required. Slope away from storage tank manholes and access boxes for drainage. Finish to smooth finish.
- B. Testing: As work progress, perform testing of components and systems to verify compliance. Perform tests in presence of Owner and Architect/Engineer. Perform tests on subsurface and concealed items prior to backfilling and cover-up.
- C. Contractor shall perform operational tests on entire fuel dispensing system when work is completed and at time of Substantial Completion.
- D. Instructions to Owner's Personnel: Contractor shall instruct Owner's personnel in the proper operation and maintenance of fuel dispensing equipment.
- E. Operational and Maintenance Manuals: Contractor shall provide properly bound and labeled fuel dispensing equipment operation and maintenance manuals. Comply with Division 1 requirements.
- F. Clean-Up and Adjust: Contractor shall remove all debris, sweep broom clean, and wipe clean to remove dirt, oil, and grease. Adjust all equipment for proper operation.

*** END OF SECTION 26 38 00 ***

SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes lightning protection for structures and structure elements.

1.3 SCOPE

- A. Provide a complete lightning protection system for the building(s), structures, etc. included on the contract drawings. The system shall provide safety for the building, the buildings contents and occupants by preventing damage caused by lightning. The design of this system is to be in strict accordance with I.E.F.F. Standards, this section of the specifications and all contract drawings that apply. Complete lightning protection shall be provided and installed for all buildings.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminals and mounting accessories.
 - 1. Layout of the lightning protection system, along with details of the components to be used in the installation.
 - 2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
- C. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.
- D. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.
- E. Field quality-control reports.
- F. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.
- G. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:
 - 1. Ground rods.
 - 2. Ground loop conductor.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by UL or LPI as a Master Installer/Designer, trained and approved for installation of units required for this Project with a minimum of five (5) years experience.
- B. System Certificate:
 - 1. UL Master Label.
 - 2. LPI System Certificate.
 - 3. UL Master Label Recertification when new buildings or structures are added to an existing site.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.
- C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96 and NFPA 780.
- B. Roof-Mounted Air Terminals: NFPA 780, Class I unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. East Coast Lightning Equipment Inc.
 - b. ERICO International Corporation.
 - c. Harger.
 - d. Heary Bros. Lightning Protection Co. Inc.
 - e. Independent Protection Co.
 - f. Preferred Lightning Protection.

- g. Robbins Lightning, Inc.
 - h. Thompson Lightning Protection, Inc.
- 2. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
- 3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in Division 07 roofing Sections.
- C. Main and Bonding Conductors: Copper.
- D. Ground Loop Conductor: The same size and type as the main conductor except tinned.
- E. Ground Rods: Copper-clad steel, 3/4 inch in diameter by 10 feet long.
- F. Lightning Protection Components: Stainless steel or solid copper.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.
- C. Conceal the following conductors:
 - 1. System conductors.
 - 2. Down conductors.
 - 3. Interior conductors.
 - 4. Conductors within normal view of exterior locations at grade within 200 feet of building.
- D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.
- E. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.
- F. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 100-foot intervals.

3.2 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

- B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL

- A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- B. UL Inspection: Meet requirements to obtain a UL Master Label for system.
- C. LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

*** END OF SECTION 26 41 13 ***

SECTION 26 43 13 - SURGE PROTECTIVE DEVICES (SPDS)

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 field-mounted SPD for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Sections:
 - 1. Division 23 Section "Variable Frequency Drives."
 - 2. Division 26 Section "Panelboards" for factory-installed TVSS.
 - 3. Division 26 Section "Wiring Devices" for devices with integral TVSS.
 - 4. Division 26 Section "Lightning Protection Systems for Structures"

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. VPR: Voltage protection rating.
- C. SPD: Surge protective device(s), both singular and plural.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.
- B. Qualification Data: For qualified testing agency.
- C. Product Certificates: For TVSS devices, from manufacturer.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For TVSS devices to include in emergency, operation, and maintenance manuals.
- F. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- D. Comply with NEMA LS 1.
- E. Comply with UL 1449, latest edition.
- F. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than seven (7) days in advance of proposed electrical service interruptions.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Service Conditions: Rate SPD devices for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 125 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F.
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 1,000 feet above sea level.

1.7 COORDINATION

- A. Coordinate location of field-mounted TVSS devices to allow adequate clearances for maintenance.
- B. Coordinate TVSS devices with Division 26 Section "Electrical Power Monitoring and Control."
- C. Coordinate the overcurrent protection amperage requirements before the circuit breakers are ordered for correct sizing.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

Warranty Period: Ten (10) years from date of Substantial Completion.

- B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

PART 2 PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advanced Protection Technologies Inc. (APT).
 2. PQ Protection.
 3. Liebert Corporation; a division of Emerson Network Power.
 4. Square D; a brand of Schneider Electric.
 5. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 6. Siemens Energy & Automation, Inc.
 7. Eaton (Cutler Hammer)
- B. Surge Protection Devices:
1. Modular.
 2. LED indicator lights for power and protection status.
 3. Audible alarm to indicate when protection has failed.
 4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 5. Surge Counter
- C. Peak Single-Impulse Surge Current Rating: 300 kA per phase/150 kA per mode(unless otherwise noted on plans).
- D. Fault Current Rating 200 kAIC.

- E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, 3-phase, 4-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 1500 V for 480Y/277 V or 1000 V for 208Y/120 V.
 - 2. Line to Ground: 1500 V for 480Y/277 V or 1000 V for 208Y/120 V.
 - 3. Neutral to Ground: 1200 V for 480Y/277 V or 800 V for 208Y/120 V.
 - 4. Line to Line: 2000 V for 480Y/277 V or 1200 V for 208Y/120 V.

2.2 PANELBOARD SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advanced Protection Technologies Inc. (APT).
 - 2. PQ Protection.
 - 3. Liebert Corporation; a division of Emerson Network Power.
 - 4. Square D; a brand of Schneider Electric.
 - 5. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 6. Siemens Energy & Automation, Inc.
 - 7. Eaton (Cutler Hammer)
- B. Surge Protection Devices:
 - 1. Non-modular.
 - 2. LED indicator lights for power and protection status.
 - 3. Audible alarm to indicate when protection has failed.
 - 4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- C. Peak Single-Impulse Surge Current Rating: 100 kA per phase/50 kA per mode (unless otherwise noted on plans).
- D. Fault Current Rating 100 kAIC.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, 3-phase, 4-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
 - 2. Line to Ground: 1200 V for 480Y/277 V or 1000 V for 208Y/120 V.

3. Neutral to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
4. Line to Line: 2000 V for 480Y/277 V or 1200 V for 208Y/120 V.

2.3 ENCLOSURES

- A. Indoor Enclosures: NEMA 250 Type 1.
- B. Outdoor Enclosures: NEMA 250 Type 3R.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 1. Provide multiple, 30 or 60-A circuit breakers as scheduled on panel directory as a dedicated disconnecting means for TVSS unless otherwise indicated.
- C. Install TVSS devices for variable frequency drives where indicated on drawings and electrical details.
 1. Tap TVSS device leads to line terminal lugs using approved UL multitap lugs.
- D. Review all installation information in owners manual. Verify all voltage before connections to avoid injury and damage to equipment. The specified unit shall be installed external to switchboard, distribution and panelboard as stand alone. Internal products will not be accepted.

3.2 STARTUP SERVICE

- A. Do not energize or connect service entrance equipment, panelboards, control terminals, or data terminals to their sources until TVSS devices are installed and connected.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.3 DEMONSTRATION

- A. Train Owner's maintenance personnel to maintain TVSS devices.

*** END OF SECTION 26 43 13 ***

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SECTION 26 43 23 - SURGE PROTECTIVE DEVICES (SPDS) FOR DATA AND ELECTRONIC EQUIPMENT

PART 1 GENERAL

1.1 WORK INCLUDED

- A. The work required under this Division shall include all materials, labor and auxiliaries required to furnish and install a complete surge protector system for the protection of building electronic systems from the effects of line induced transient voltage surge and lightning discharge as indicated on drawings and specified in this section.
- B. Related work specified elsewhere:
 - 1. Division 27 Communications.
 - 2. Division 28 Electronic Safety and Security.

1.2 QUALITY ASSURANCE

- A. All transient voltage surge protector devices shall be manufactured by a company normally engaged in the design, development, and manufacture of such devices for electronic systems equipment.
- B. The surge protector manufacturer shall offer technical assistance through support by a factory representative and local stocking distributor.
- C. Surge protectors provided shall not interrupt power to the protected system in the event of protector failure.
- D. Surge protectors provided shall not impair the performance of the protected system (i.e., degradation of signal quality or level, attenuation, distortion, etc.). The protector shall not initiate conditions which jeopardize the life safety features of fire alarm, communication, energy management, and other code related protection.
- E. Surge protector submittals shall include:
 - 1. Schematic data on each protector type indicating component types.
 - 2. Dimensioned drawing of each protector type.
 - 3. Manufacturer's performance data for each protector type.
 - 4. Manufacturer shall furnish complete maintenance and installation manuals and a list of replacement parts.
 - 5. Manufacturer shall provide independent third party test data confirming unit will not have any holdover current.
- F. Equipment Certification: Items shall be listed by Underwriters' Laboratories, shall bear the UL seal and be marked in accordance with referenced standards.

- G. Surge protector devices shall be installed and located in accordance with requirements of all applicable National Fire Protection Association (NFPA) Codes.

1.3 WARRANTY

- A. All surge protector devices shall be warranted for a minimum period of ten (10) years with free replacement of the device by the Manufacturer if the device fails to perform for any reason within those ten (10) years.
- B. Any protector which shows evidence of failure or incorrect operation during the warranty period shall be replaced/installed by the Manufacturer and installer.

1.4 CODES AND STANDARDS

- A. The following standards and publications (current editions) are referenced in various parts of this specification and shall apply.
 - 1. UL 1449, Latest Edition—Surge Suppressive Devices.
 - 2. UL 1363—Standard for Relocatable Power Taps.
 - 3. ANSI/IEEE C62.41 (IEEE 587)—Guide for Surge Voltages in Low-Voltage AC Power Circuits.
 - 4. ANSI/IEEE C62.45—IEEE Guide for Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
 - 5. MIL-STD-220A—50 Ohm Insertion Loss Method.
 - 6. ANSI/IEEE—Standard C62.33—IEEE Test Specifications for Varistor Surge Protective Devices.
 - 7. ANSI/IEEE—Standard C62.31—IEEE Standard Test Specification for Gas Tube Surge Protective Devices.
 - 8. IEEE—Standard C62.34—Standard Test Specifications for Avalanche Junction Semiconductor Surge Protective Devices.
 - 9. UL 498—Standard for Electrical Attachment Plugs and Receptacles.
 - 10. NEMA LS1—National Codes and Standards.
 - 11. Federal Information Processing Standards Publication 94.
 - 12. NFPA 70—National Electrical Code.
 - 13. UL 1283—Standard for Electromagnetic Interference Filters.
 - 14. UL 497A—Standard for Secondary Protectors for Communication Circuits.
 - 15. UL 497B—Standard for Protectors for Data Communication and Fire Alarm Circuits.
 - 16. UL 1410—Standard for Television Receivers and High Voltage Video Products.

- B. Systems/equipment manufacturer(s) who can document that their system/equipment can withstand surge levels and waveforms of the appropriate exposure category described in ANSI/IEEE 62.41 (IEEE 587) shall not have to provide surge protectors for their system/equipment.
- C. Provide third party certified documentation based on ANSI/IEEE C62.41 exposure categories and waveforms for all manufacturer supplied surge protectors for both power and signal wiring.

1.5 REQUIRED PROTECTORS

- A. Provide UL transient voltage surge protectors for the equipment described herein and as indicated on the drawings:
 - 1. On each conductor pair and cable sheath entering or leaving a building.
 - 2. On all power and data connections for the fire alarm system.
 - 3. On all power and data connections for the telephone system.
 - 4. On all power and data connections for the computer/data system.
 - 5. On all power and data connections for EMS panels.
 - 6. On all power and data connections for access control system.
 - 7. On all power and data connections for television system.
 - 8. On all power and data connections for coaxial cable system.
 - 9. On all power and data connections for surveillance system.

PART 2 PRODUCTS

2.1 PROTECTORS FOR FIRE ALARM CIRCUITS

- A. Protectors shall be installed on all fire alarm system circuits and cables on points of entry and exit from separate buildings, and other locations where direct exposure to lightning occurs. Protectors shall meet the following criteria:
 - 1. Must be UL 497B listed and labeled.
 - 2. Multi-stage hybrid protection design.
 - 3. Plug-in replaceable system design or individually mounted units.
 - 4. Fail-short/fail-safe mode.
 - 5. Surge Capacity: 3000 amp (8/20 μ s waveform).
 - 6. Clamp Voltage: 150% of circuit peak operating voltage (2000 A, 8/20 μ s waveform).
 - 7. Maximum Continuous Operating Voltage: At least 125% of peak operating voltage.

8. Acceptable Manufacturers:
 - a. EDCO.
 - b. DITEK.

2.2 PROTECTORS FOR TELEPHONE CIRCUITS

- A. Protectors shall be installed on all telephone system circuits and cables on points of entry and exit from separate buildings, and at roof mounted locations or where direct exposure to lightning occurs. Protectors shall meet the following criteria:
 1. Must be UL 497A listed and labeled.
 2. Multi-stage hybrid protection design.
 3. Fail-short/fail-safe mode.
 4. Surge Capacity: 10 kA (8/20 μ s waveform).
 5. Clamp Voltage: 150% of circuit peak operating voltage (2000 A, 8/20 μ s waveform).
 6. Pulse Life: 2,000 impulses of Category C1 waveform (3 kA, 8/20 μ s).
 7. Maximum Continuous Operating Voltage: At least 125% of peak operating voltage.
 8. Acceptable Manufacturers:
 - a. AT&T.
 - b. EDCO.
 - c. DITEK.

2.3 PROTECTORS FOR ENERGY MANAGEMENT AND CONTROL SYSTEMS (EMCS)

- A. Protectors shall be installed on all EMCS circuits and cables on points of entry and exit from separate buildings, and at roof mounted locations or where direct exposure to lightning occurs. Protectors shall meet the following criteria:
 1. Must be UL 497B listed and labeled.
 2. Multi-stage hybrid protection design.
 3. Plug-in replaceable system design or individually mounted units.
 4. Fail-short/fail-safe mode.
 5. Surge Capacity: 3000 amp (8/20 μ s waveform).
 6. Clamp Voltage: 150% of circuit peak operating voltage (2000 A, 8/20 μ s waveform).
 7. Maximum Continuous Operating Voltage: At least 125% of peak operating voltage.

8. Acceptable Manufacturers:
 - a. Advanced Protection Technologies.
 - b. EDCO.
 - c. DITEK.

2.4 PROTECTORS FOR SECURITY SYSTEMS

- A. Protectors shall be installed on all security system circuits and cables on points of entry and exit from separate buildings, and at roof mounted locations or where direct exposure to lightning occurs. Protectors shall meet the following criteria:
 1. Must be UL 497B listed and labeled.
 2. Multi-stage hybrid protection design.
 3. Plug-in replaceable system design or individually mounted units.
 4. Fail-short/fail-safe mode.
 5. Surge Capacity: 3000 amp (8/20 μ s waveform).
 6. Clamp Voltage: 150% of circuit peak operating voltage (2000 A, 8/20 μ s waveform).
 7. Maximum Continuous Operating Voltage: At least 125% of peak operating voltage.
 8. Acceptable Manufacturers:
 - a. Advanced Protection Technologies.
 - b. EDCO.
 - c. DITEK.

2.5 PROTECTORS FOR COMPUTER/DATA CIRCUITS

- A. Protectors shall be installed on all computer/data circuits and cables on points of entry and exit from separate buildings, and at roof mounted locations or where direct exposure to lightning occurs. Protectors shall meet the following criteria:
 1. Must be UL 497B listed and labeled.
 2. Multi-stage hybrid protection design.
 3. Plug-in replaceable system design or individually mounted units.
 4. Fail-short/fail-safe mode.
 5. Surge Capacity: 3000 amp (8/20 μ s waveform).
 6. Clamp Voltage: 150% of circuit peak operating voltage (2000 A, 8/20 μ s waveform).

7. Maximum Continuous Operating Voltage: At least 125% of peak operating voltage.
8. Acceptable Manufacturers:
 - a. Advanced Protection Technologies.
 - b. EDCO.
 - c. DITEK.

2.6 PROTECTORS FOR TELEVISION DISTRIBUTION

- A. Protectors shall be installed on each TV coaxial cable on points of entry and exit from separate buildings, and at roof mounted and other locations where direct exposure to lightning occurs. Protectors shall meet the following criteria:
 1. Shunt clamping elements: Gas tubes and high energy bipolar silicon avalanche diodes separated by a series resistance.
 2. Electrical Parameters:
 - a. Impedance: Match the existing system being protected.
 - b. Capacitance: Less than 25 pF.
 - c. Insertion Loss: Less than 0.2 dB.
 - d. Maximum Single Impulse Current: At least 20 kA (8/20 us waveform).
 - e. Clamping Voltage: Less than 200% of normal peak operating voltage.
 - f. Response Time: Less than one nanosecond.
 3. Acceptable Manufacturers:
 - a. Citel America.
 - b. Advanced Protection Technologies.
 - c. DITEK.

2.7 PROTECTORS FOR COAXIAL CABLES

- A. Protectors shall be installed on coaxial cable systems on points of entry and exit from separate buildings, and at roof mounted and other locations where direct exposure to lightning occurs. Protectors shall meet the following criteria:
 1. Shunt Clamping Elements: Gas tubes and high energy bipolar silicon avalanche diodes separated by a series resistance.

2. Electrical Parameters:
 - a. Impedance: Match the existing system being protected.
 - b. Capacitance: Less than 25 pF.
 - c. Insertion Loss: Less than 0.2 dB.
 - d. Maximum Single Impulse Current: At least 20 kA (8/20 us waveform).
 - e. Clamping Voltage: Less than 200% of normal peak operating voltage.
 - f. Response Time: Less than one nanosecond.
3. Acceptable Manufacturers:
 - a. Citel America.
 - b. Advanced Protection Technologies.
 - c. DITEK.

2.8 POWER SUPPRESSORS FOR ELECTRONIC EQUIPMENT/SYSTEMS

- A. Permanently installed hard wired receptacle suppressors.
 1. 125V, 20A, hospital grade, straight blade, NEMA 5-20R, Decora style with blue color face and cover plate, Leviton 8380 Series.

2.9 PERFORMANCE CRITERIA FOR HARD WIRED RECEPTACLES

- A. Suppressors shall have a minimum single surge capacity of 10,000 amps L-N, 5,000 amps L-G and N-G.
- B. Suppressors shall have a UL clamping voltage rating not to exceed 500 volts for any mode.
- C. Suppression modes shall be L-N, L-G, and N-G.
- D. Suppressors shall be designed with visible diagnostic status indicators to indicate the proper suppressors connection and operation. Audible alarm shall be provided when specified.
- E. Suppressors shall be tested as per ANSI/IEEE C62.41, Category A Test Criteria to determine clamping voltage ratings.
- F. Suppressors shall be sequential surge tested as per ANSI/IEEE C62.45 and shall withstand 1000 test cycles at Category C3 test criteria.
- G. Acceptable Manufacturers:
 1. Hubbell
 2. Ortronics

PART 3 EXECUTION

3.1 INSTALLATION

SPD and lightning arresters along with required grounding and bonding which are provided as part of this contract shall be installed on all electronic systems. Owner provided electronics are excepted unless specifically noted on the drawings. Installers shall be experienced as master or journeyman electricians, or of equivalent qualification as approved by the engineer.

- A. SPD equipment shall be installed on each metallic electrical conductor entering or leaving the facility. SPD equipment shall be installed on each metallic data or communication conductor entering and leaving the building.
- B. Install SPD equipment according to manufacturer's recommendations.
- C. All electronic equipment/systems utilizing cord and plug or hard wired to the building electrical system provided under this contract shall be provided with a three-stage, single or multi-phase, hybrid suppressor.
- D. Contractor must properly match SPD equipment to equipment being protected, including wire sizes, operating voltages, and currents.
- E. Contractor must coordinate with providers of all equipment being protected and provide SPD equipment which meets these specifications.
- F. Suppressors shall be listed as per UL 1449 as per their intended use and installed as close as practical to the electric panel or electronic equipment to be protected, consistent with available space.
- G. Suppressors shall be installed in a neat, workmanlike manner. Lead dress shall be as short and as straight as possible and be consistent with recommended industry practices for the system on which these devices are installed.
- H. Equipment shall be installed following manufacturer's recommendations and guidelines in compliance with NEC Article 250/285 for grounding and bonding; NEC Article 110.9 and 110.10 for overcurrent protection.
- I. Provide required enclosures (NEMA-1 indoor or NEMA-3R outdoor) for protectors either adjacent to each electronic system cabinet or coordinate with each electronic system supplier to provide cabinet large enough to include mounting protectors within system cabinet.
- J. Electronic system equipment shall be protected by treating groups of related devices as a "cluster" and protecting all hardwire circuiting which enters or leaves the "cluster." All equipment chases within a protected "cluster" shall be bonded to a common ground bar at the "window" location for the "cluster." The "window" is the common point where all hardwire circuits enter or leave the "cluster."

3.2 GROUND INSTALLATION

- A. Ground Bus Connections
 - 1. Provide local ground bus in each terminal cabinet housing surge protection equipment (with other materials as required).

2. Bond local ground bus to terminal cabinet with minimum #6 copper wire.
3. Connect terminal cabinet local ground bus to systems ground bus with minimum #6 copper insulated wire (unless otherwise noted) in conduit.
4. Note that the systems ground bar is also to be used for power transformation ground (480 V to 208 V) where applicable.

B. Surge Protector Equipment Grounding

1. Connect each protector to local ground bus in terminal cabinet with wire sized as recommended by manufacturer. Where M block type terminations/protectors are used, bond ground rail to local ground bar with wire as recommended by manufacturer.
2. Coordinate with (120 V - 480 V SPD) contractor to ensure that 120 VAC power source/supply suppressor is also grounded to same local ground bus as protectors provided in this section for same system (i.e., fire alarm, intercom, television, etc.).

C. Grounding Conductors

1. Conductors shall be a minimum size of #12 THWN (in conduit, insulated) unless otherwise noted or otherwise recommended by the manufacturer.
2. Conductors shall be as short as possible.
3. No bend radius shall be less than 6 inches or more than 90 degrees.
4. Conductors shall be secured at 12 inch intervals with an approved copper clamp.
5. Grounding conductors shall be properly connected to the building service ground by approved method.
6. Do not bundle unprotected conductors with protected conductors.
7. Ground and bond conductors shall not be "daisy chained" between SPD devices. Each device shall have its own ground or bond conductor.

D. Grounding Connectors

1. Connectors, splicers, and other fittings used to interconnect grounding conductors, or bond to equipment or grounding bars, shall be approved by UL or NEC for the purpose.
2. All connectors and fittings shall be of the Nicopress crimp or compression set-screw type (solderless connection).
3. Special treatment to fittings, lugs, or other connectors of dissimilar material shall be applied to prevent electrogalvanic action.

*** END OF SECTION 26 43 23 ***

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SECTION 26 51 00 – INTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. CU: Coefficient of utilization.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.
- G. RCR: Room cavity ratio.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.

2. Emergency lighting units including battery and charger.
 3. Ballast.
 4. Energy-efficiency data.
 5. Life, output, and energy-efficiency data for lamps.
 6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
 - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
1. Wiring Diagrams: Power and control wiring.
- C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Lighting fixtures.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems for lighting fixtures will be attached.
 4. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Access panels.
 5. Perimeter moldings.
- D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:
1. Lamps: Specified units installed.

2. Accessories: Cords and plugs.
- E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- F. Qualification Data: For agencies providing photometric data for lighting fixtures.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- 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 NFPA 70.
- D. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
- B. Special Warranty for LED Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace LED boards and drivers that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: Five year(s) from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Battery and Charger Data: One for each emergency lighting unit.
 - 3. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Refer to the Luminaire Schedule on the drawings for a list of acceptable manufacturers.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. LED Fixtures:
 - 1. Driver shall be installed in an electrical enclosure.
 - 2. Wiring inside enclosure shall comply 600V/105 degrees rating or higher.
 - 3. LED driver shall comply with UL standard UL1012.
 - 4. LED driver shall have Class A sound rating.
 - 5. LED driver shall be UL certified for use in a dry or damp location.
 - 6. LED driver shall tolerate sustained open circuit and short circuit output conditions without damage.
 - 7. LED driver shall comply with the requirements of the FCC rules and regulations, Title 47 CFR Part 15 Non-Consumer (Class A).
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

- F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- G. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.
- H. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.3 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 - 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

- f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
3. Master/Remote Sign Configurations:
- a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in ballast for power connection to remote unit.
 - b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.4 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.
- 1. Battery: Sealed, maintenance-free, lead-acid type.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 6. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
 - 7. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - 8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.5 LAMPS

- A. Incandescent Lamp—Not Allowed.

- B. Fluorescent Lamp—Not Allowed
- C. Reflector Lamp Beam Patterns—ANSI C78.379.
- D. Exit signs—LED.
- E. LED color temperature—refer to drawings.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Lighting Fixtures 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 fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

- C. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Adjust aimable lighting fixtures to provide required light intensities.
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

*** END OF SECTION 26 51 00 ***

SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with lamps and ballasts.
 - 2. Luminaire-mounted photoelectric relays.
 - 3. Poles and accessories.
 - 4. Luminaire lowering devices.
- B. Related Sections include the following:
 - 1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

- A. CRI: Color-rendering index.
- B. LED: Light Emitting Diode.
- C. Luminaire: Complete lighting fixture, including ballast housing if provided.
- D. Pole: Luminaire support structure, including tower used for large area illumination.
- E. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.
- C. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
 - 1. Wind speed for calculating wind load for poles exceeding 50 feet in height is 195 mph (3-second gust).

2. Wind speed for calculating wind load for poles 50 feet or less in height is 160 mph (3-second gust).

1.5 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 2. Details of attaching luminaires and accessories.
 3. Details of installation and construction.
 4. Luminaire materials.
 5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
 - a. For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 - b. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 6. Photoelectric relays.
 7. Ballasts, including energy-efficiency data.
 8. Lamps, including life, output, and energy-efficiency data.
 9. Materials, dimensions, and finishes of poles.
 10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 11. Anchor bolts for poles.
 12. Manufactured pole foundations.
- B. Shop Drawings:
 1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
 3. Wiring Diagrams: Power and control wiring.
- C. Samples for Verification: For products designated for sample submission in Exterior Lighting Device Schedule. Each sample shall include lamps and ballasts.

- D. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.
- E. Qualification Data: For agencies providing photometric data for lighting fixtures.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- C. 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.
- D. Comply with IEEE C2, "National Electrical Safety Code."
- E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch deep. Do not apply tools to section of pole to be installed below ground line.
- D. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
 2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
 4. Warranty Period for LED luminaires and drivers: Five years from the date of Substantial Completion.
 5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Glass and Plastic Lenses, Covers, and Other Optical Parts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 2. Globes and Guards: 10 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Refer to the Luminaire Schedule on the drawings for a list of acceptable manufacturers.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- M. Factory-Applied Finish for Steel luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of manufacturer's standard color.
 - c. Color: As selected by Architect from manufacturer's full range.
- N. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: Light bronze, Medium bronze, Dark bronze, or Black.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
 1. Relay with locking-type receptacle shall comply with NEMA C136.10.
 2. Adjustable window slide for adjusting on-off set points.

2.4 LED FIXTURES:

1. Driver shall be installed in an electrical enclosure.
2. Wiring inside enclosure shall comply 600V/105 degrees rating or higher.
3. LED driver shall comply with UL standard UL1012.
4. LED driver shall have Class A sound rating.
5. LED driver shall be UL certified for use in a dry or damp location.
6. LED driver shall tolerate sustained open circuit and short circuit output conditions without damage.
7. LED driver shall comply with the requirements of the FCC rules and regulations, Title 47 CFR Part 15 Non-Consumer (Class A).

2.5 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.

2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 1. Materials: Shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
 3. Anchor-Bolt Template: Plywood or steel.
- D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.
- F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.6 PRE-STRESSED, SPUN CONCRETE POLES

- A. Poles: Manufactured of cast concrete.
 1. Shape: Square, tapered
 2. Mounting Provisions: Direct burial.
 3. Finishing: Capped at top and plugged at bottom. Seat each steel reinforcing strand with epoxy adhesive.
 4. Grounding: Continuous copper ground wire cast into pole. Terminate at top of pole.
- B. Cure with wet steam and age for a minimum of 15 days before installation.
- C. Fabricate poles with a hard, nonporous surface that is resistant to water, frost, and road and soil chemicals and that has a maximum water-absorption rate of 3 percent.
- D. Cast aluminum nameplate into pole wall at approximately 5 feet above ground line, listing name of manufacturer, Project identifier, overall height, and approximate weight.
- E. Pole Brackets: Comply with ANSI C136.13.

- F. Finish Color: Provided by color material complying with ASTM C 979, uniformly impregnated throughout the pole concrete. Color material shall provide a uniform, stable, permanent color and be as follows:
 - 1. Inert, and carbon free.
 - 2. Unaffected by environmental conditions and contaminants including, but not limited to, UV solar radiation, salts, and alkalis.
- G. Finish Texture: Etched finish.

PART 3 EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

3.2 POLE INSTALLATION

- A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: 60 inches.
 - 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
 - 3. Trees: 15 feet.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 3. Install base covers, unless otherwise indicated.

4. Use a short piece of 1/2-inch-diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.
- F. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 1. Install grounding electrode for each pole, unless otherwise indicated.
 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 1. Install grounding electrode for each pole.
 2. Install grounding conductor and conductor protector.
 3. Ground metallic components of pole accessories and foundations.

3.7 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
 - a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting."
 - b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
 - c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
 - d. IESNA LM-64, "Photometric Measurements of Parking Areas."
 - e. IESNA LM-72, "Directional Positioning of Photometric Data."
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices. Refer to Division 01 Section "Demonstration and Training."

*** END OF SECTION 26 56 00 ***

SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

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 Division.
- B. Related Sections:
 - 1. Division 28 Section "Common Work Results for Electronic Safety and Security."

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves for Pathways and Cables.
 - 2. Grout.
 - 3. Common Communications Installation Requirements.

1.3 SCOPE OF WORK FOR ENTIRE DIVISION 27

- A. REFER TO DRAWINGS FOR LOW VOLTAGE SYSTEM SCOPE OF WORK.

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
 - 1. To allow maximum possible headroom, unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting pathways, cables, wireways, cable trays, and busways shall be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components, as they are constructed.
- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with firestopping selection and application as specified in Division 07 Section "Penetration Firestopping" and per BICSI TDMM, "Firestopping Systems" Article.

PART 2 PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. For firestopping, provide fittings that have been UL tested for through-penetration firestops. Fittings shall be passive and designed for use on both sides of a wall/floor. Provide in galvanized finish and in sizes required through firewalls. Acceptable Manufacturer: Wiremold FlameStopper.

2.2 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items, unless indicated otherwise in the specific section.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- D. Cut sleeves to length for mounting flush with both surfaces of walls unless noted otherwise on drawings.
- E. Size pipe sleeves to provide, at a minimum, a 1/4-inch, annular clear space between sleeve and pathway or cable, unless indicated otherwise.

- F. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- G. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- H. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- I. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and provide weathertight joints. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Underground, Exterior-Wall Penetrations: Install steel pipe sleeves and provide watertight joints. Comply with requirements in Division 07 Section "Joint Sealants."

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations. Comply with requirements in Division 07 Section "Joint Sealants."
- B. Use 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.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Comply with BICSI TDM, "Firestopping Systems" Article.

3.5 CONCRETE WORK

- A. This Contractor shall be responsible to replace concrete pads, supports, piers, bases, foundations, and encasements damaged from the installation of the Work under this Division.

3.6 PAINTING OF DAMAGED AREAS

- A. Raceways, conduit supports, hangers, and surface raceway, where exposed, shall be painted to match mounting surface or surrounding surfaces. Panels and equipment with damaged painted surfaces shall be refinished to previous conditions.

3.7 WARRANTY FOR ENTIRE DIVISION 27 (UNLESS NOTED OTHERWISE IN SECTION)

- A. The Contractor shall and does hereby warrant all workmanship, materials, and equipment furnished under this scope of work to be free from defects and function or operate satisfactorily for a period of one year from Substantial Completion of this project unless noted otherwise in specific specification section.

- B. If any defects are found within the warranty period, the defective equipment shall be replaced at no cost; the one year warranty shall include labor.
- C. Contactor shall respond, excluding weekends and holidays, within 24 hours to any warranty service calls. If equipment cannot be repaired within 24 hours of service visit, the Contractor shall provide "loaner" equipment to the facility at no charge.

*** END OF SECTION 27 05 00 ***

SECTION 27 15 00 - TELEPHONE SERVICE ENTRANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Telephone Service Entrance Raceway.
- B. Equipment and Terminal Backboards.

1.2 RELATED SECTIONS

- A. Division 26 Conduit, Supporting Devices, Electrical Identification, etc.

1.3 QUALITY ASSURANCE

- A. Telephone Utility Company: Verizon.
- B. Install work in accordance with Telephone Utility Company's rules and regulations.

1.4 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Division 1.
- B. Accurately record location of service entrance conduit and termination backboards.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify that field measurements are as shown on drawings.

3.2 INSTALLATION

- A. Support raceways under the provisions of Division 26.
- B. Install pullwire in each empty service providers' conduit.

*** END OF SECTION 27 15 00 ***

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SECTION 27 51 25 - INTERCOMMUNICATION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. System Devices.
- B. Cabling.
- C. Equipment Mounting.
- D. System Testing.

1.2 RELATED SECTIONS

- A. Division 26.....Building Wire and Cable, Boxes, Electrical Identification, etc.

1.3 SCOPE OF WORK

- A. Installer shall provide all necessary tools, equipment, material and labor required to install complete intercom system, as described in this specification.
- B. This specification is specifically applicable to Division 16 Sections, in addition to Division 1—General Requirements, General Conditions, and Supplementary General Conditions.

1.4 CODES AND STANDARDS

- A. National Electric Code (N.E.C.).
- B. Florida Building Code.
- C. Manufacturer installation instructions.
- D. Execution portion of this guideline.
- E. In the event the execution portion of the guideline exceeds the above codes and standards, the execution section shall be followed.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in this type of system, with five years documented experience. Installing and servicing office to be located within a 75 mile radius of the job site.
- B. Installer: Company specializing in this type of system, with five years' experience, certified by Florida State Licensing Board as an installing contractor. The installer shall be factory authorized service representative (submit certification number) and show evidence of having successfully completed at least three similar projects in the local area, each having an installed service period of three years minimum of satisfactory performance.

- C. The Contractor shall show evidence upon request that they maintain a fully equipped service organization capable of furnishing adequate inspection and service to the system, including a stock or replacement parts. Replacement parts shall include at least one of every device used on the system to include control panels.
- D. The Contractor shall be prepared to offer a service contract for the maintenance of the system after the warranty period.

1.6 PRE-BID SUBSTITUTION REQUESTS

- A. Under provisions of Division 1 and Section 26 05 00.
- B. Submit any requests for substitutions or deviations prior to bid opening. Only those requests that are complete and approved by the Engineer in written Addendum form shall be accepted.

1.7 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.
- B. The following items shall be submitted to the Engineer for review and approval. Submittals shall include, but not be limited to, the following:
 - 1. Spreadsheet with product numbers and quantities marked for all equipment.
 - 2. Specifications and data sheets for each item.
 - 3. Scaled layout of mounted equipment showing locations and relationship for equipment location.

PART 2 PRODUCTS

2.1 GENERAL

- A. Intercom shall function as follows: A call signal from a remote station shall activate a call tone on the Master Stations. The call tone shall last as long as the call button is being pressed on the remote. Any Master shall be able to answer by pressing the "TALK" button, holding the "TALK" button to transmit, and releasing to listen. The person at the remote station shall be able to speak hands free. Masters shall be able to push a button to remotely release door via connection to Access System's REX motion detector.
- B. Cabling and distance from the door to the Master Stations shall be per manufacturer's recommendations.

2.2 INTERCOM MASTER STATIONS

- A. Provide an open voice, selective calling type intercom with one channel for communication to a remote station. Provide two master stations, each answering the remote, each releasing the door, and each with their own power source.
- B. No master-to-master communication is required.

- C. Master Station shall be equipped with a door release button, providing a normally open contact. Other controls shall include TALK and OFF buttons, voice and call tone volume controls. An "Occupied" LED shall indicate if the system is in use.
- D. Acceptable Manufacturers:
 - 1. Aiphone LEM-1DLC (one to be provided in the Day Room and one to be provided in the Office), with Aiphone PT-1210N (power supply).

2.3 SUB-STATION

- A. Provide vandal proof and weather resistant substation constructed of 11-gauge carbon steel with a white powder-coated finish. Flush mount using a standard, three gang, electrical box. Provide with tamper proof screws and tool for installation.
- B. Acceptable Manufacturers:
 - 1. Aiphone LS-NVP/C.

2.4 SURGE SUPPRESSION

- A. As required, intercom installation shall include appropriate lightning and transient voltage surge suppression/protection per manufacturer's requirements.

PART 3 EXECUTION

3.1 GENERAL

- A. Contractor shall follow established guidelines for installation and termination of all cabling and equipment as established in Part 1 of this Specification.
- B. Work shall be of professional quality and shall not detract from the aesthetic qualities of the facility. Contractor shall ensure that the site is clean of construction debris prior to leaving the site unsupervised at the end of every work day.

3.2 INSTALLATION OF INTERCOM SYSTEM

- A. Install intercom systems as indicated, in accordance with equipment manufacturer's written instructions.
- B. Contractor shall provide all equipment required for the installation of the intercom system.

3.3 PENETRATIONS

- A. Fire penetrations: Fire stop all fire penetrations I.A.W. published UL standards. It is this Contractor's responsibility to identify fire walls.
- B. Masonry penetrations: Masonry penetrations to install materials shall be saw-cut for square or irregular penetrations, masonry drilled for round penetrations 1" diameter or less, or core drilled for round penetrations larger than 1" diameter. Under no circumstances shall masonry penetrations be chipped or hammered.

- C. Provide necessary sleeves and chases where conduits pass through walls. Wall sleeves shall be installed above ceiling and be supported on both sides of the wall with strut and beam clamps. Ream and bush both sides of sleeves.

3.4 PAINTING OF DAMAGED AREAS

- A. Raceways, conduit supports, hangers, and surface raceway, where exposed, shall be painted to match mounting surface or surrounding surfaces. Panels and equipment with damaged painted surfaces shall be refinished to previous conditions.

3.5 COMPLETION AND TESTING

- A. Furnish to the Owner, a written report which certify that the devices have been tested and which indicates the result of the inspection. Additionally, furnish to the Owner, three sets of Operation and Maintenance manuals with parts list and other information necessary for the proper operation and maintenance on the system, as installed. Include three copies of complete troubleshooting and repair manuals. Provide Owner with a CD-ROM or USB drive copy and two printed copies as-built drawings indicating location of conduit, junction boxes and equipment.
- B. Upon completion of installation, system shall be completely checked-out and tested by a factory-authorized representative, to determine that the system was tested and installed in accordance with the manufacturer's instructions and all applicable codes. Results of the check out and testing shall be reported in writing to the Engineer. The written report shall precede or accompany the Contractor's request for acceptance inspection for work under this Section. This representative shall prepare an inspection report for the Owner and instruct the Owner's personnel in the operation of the system.
- C. All initial software programming shall be provided.
- D. The Contractor, at no cost to the Owner, shall immediately replace all equipment, devices, and/or work found to be defective.
- E. Contractor shall turn over a turnkey intercom system.
- F. Site Test:
 - 1. Check and test installation for shorts, ground, and circuit continuity.
 - 2. Cables: Test free from opens, grounds, or crosses (shorts) between conductors.
 - 3. Walk-test doors and keypads/readers for proper function and operation.
 - 4. Test all functions on intercom system for proper functions and operations.
 - 5. Verify signals are properly received.
- G. Contractor shall finish, at completion of Contract, as-built drawings for complete system (electronic and three copies). Such drawings must include at a minimum:
 - 1. Layout diagrams with appropriate interconnection information.
 - 2. Complete cable routings and locations of all devices pertinent to the operation and maintenance of the system.

3.6 TRAINING

- A. Provide eight hours total, broken up as designated by Owner, at the site with the Owner's maintenance staff and designated staff on the operation, maintenance, troubleshooting, and repair of the system. Training shall be certified by the manufacturer. Training shall take place at time of Substantial Completion. Obtain a signed roster of all personnel that attends the training sessions and submit a copy of the roster to the Engineer and the Owner.

3.7 WARRANTY

- A. Provide warranty response information inside system panel.
- B. Equipment, parts, and labor shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion and acceptance of system by Owner.
- C. Warranty shall include damage from lightning and transients for a period of one year.
- D. Contractor shall arrive on site within four normal business hours to repair system under warranty. All repairs shall be completed within 24 hours. Failure to respond in time specified shall result in the Owner making repairs and charging warrantor and shall not affect the warranty.
- E. Equivalent loaner equipment with same functions and features will be accepted if system is completely inoperable.

*** END OF SECTION 27 51 25 ***

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SECTION 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

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 Division.
- B. Related Sections:
 - 1. Division 27 Section "Common Work Results for Communications."

1.2 SUMMARY

- A. Section Includes:
 - 1. Scope of Work for Project and Entire Division 28.
 - 2. Contractor Qualifications for Entire Division 28.
 - 3. Definitions for Entire Division 28.
 - 4. Pre-Bid and Submittal Requirements for Entire Division 28.
 - 5. Electronic Safety and Security Equipment Coordination and Installation.
 - 6. Sleeves for Raceways and Cables.
 - 7. Sleeve Seals.
 - 8. Grout.
 - 9. Common Electronic Safety and Security Installation Requirements.
- B. Utilize common horizontal pathways, as depicted on drawings and specified in Division 27.

1.3 SCOPE OF WORK FOR PROJECT

- A. This project provides for new fire station and associated systems.

1.4 SCOPE OF WORK FOR ENTIRE DIVISION 28

- A. Contractor shall be responsible for providing complete, functional systems, whether ancillary devices/components are included in this specification or not.
- B. In addition to material and equipment, Contractor shall provide labor and any incidental material required for installation.

- C. The work performed under this specification shall be of good quality and performed in a professional manner. In this context, "good quality" means the work shall meet industry technical standards and quality of appearance. The Owner/Engineer reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.
- D. It is the intent for Division 28 to utilize the conduit and ground pull boxes that Division 27 is providing for a common backbone utility corridor. Coordinate all requirements with other trades prior to submitting shop drawings.

1.5 CONTRACTOR QUALIFICATIONS FOR ENTIRE DIVISION 28

- A. This Contractor shall be able to submit proof that they meet the following qualifications upon request from the Engineer.
 - 1. Contractor must be able to prove to the satisfaction of the Owner/Engineer that it has significant experience in the installation of electronic safety and security systems. Installation must include a knowledge of interconnect equipment and a thorough knowledge of testing procedures.
 - a. Manufacturer: Company specializing in smoke detection and fire alarm systems with no less than five years documented experience.
 - b. Installer: Company specializing in smoke detection and fire alarm systems with no less than five years' experience, certified by Florida State Licensing Board as a fire alarm system installing contractor (EF or EC).
 - 2. The Contractor shall maintain a permanent office within 75 miles of the project site.

1.6 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. IDC: Insulation displacement connector.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

1.7 PRE-BID SUBSTITUTIONS FOR ENTIRE DIVISION 28

- A. Under provisions of Division 01 and General and Supplementary Conditions Specification Sections.
- B. Submit any requests for substitutions or deviations prior to bid opening. Only those requests that are complete and approved by the Engineer in written addendum form shall be accepted.

1.8 SUBMITTALS TO ENCOMPASS THE ENTIRE DIVISION 28 (UNLESS NOTED OTHERWISE IN SECTION)

- A. The Contractor shall submit per Division 01. The submission shall consist of five major sections with each section separated with insertable index tabs.
 - 1. The first section shall be the "Index" which shall include the project title and address, and name of the firm. The contents of each section shall be listed on the index.

2. The second section shall include a copy of the Contractor's valid State license and a list of instrumentation to be used for system testing.
 3. The third section shall contain the wiring diagrams, point to point with voltage drop calculations, data sheets, and equipment ratings, layout, dimensions, finishes, and battery calculations.
 4. The fourth section shall contain samples of proposed cable markers and labeling.
 5. The fifth section shall contain scaled floor plans with any wall mounted backloads and equipment locations shown, and grounding (indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets).
 6. Attach: Include disk copy and three hard copies of an AutoCAD drawing showing the jack numbering at each jack location and the patch panel jack numbering per room.
- B. The Contractor shall provide the shop drawing submittals within 60 days of receipt of contract. No work shall begin nor equipment be ordered without an engineer accepted shop drawing submittal.

1.9 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 3. To allow right of way for piping and conduit installed at required slope.
 4. So connecting raceways, cables, wireways, cable trays, and busways shall be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

- B. For firestopping, provide fittings that have been UL tested for through-penetration firestops. Fittings shall be passive and designed for use on both sides of a wall/floor. Provide in galvanized finish and in sizes required through firewalls. Acceptable Manufacturer: Wiremold FlameStopper.

2.2 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR SAFETY AND SECURITY PENETRATIONS

- A. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- D. Cut sleeves to length for mounting flush with both surfaces of walls unless noted otherwise on drawings.
- E. Size pipe sleeves to provide , at a minimum, a ¼-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

- F. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- G. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- H. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- I. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- J. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations. Comply with requirements in Division 07 Section "Joint Sealants."
- B. Use 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.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly.

3.5 PAINTING OF DAMAGED AREAS

- A. Raceways, conduit supports, hangers, and surface raceway, where exposed, shall be painted to match mounting surface or surrounding surfaces. Panels and equipment with damaged painted surfaces shall be refinished to previous conditions.

3.6 WARRANTY FOR ENTIRE DIVISION 28 (UNLESS NOTED OTHERWISE IN SECTION)

- A. The Contractor shall and does hereby warrant all workmanship, materials, and equipment furnished under this scope of work to be free from defects and function or operate satisfactorily for a period of one year from Substantial Completion of this project unless noted otherwise in specific specification section. Provide Owner with telephone number of to be called in the event of equipment failure
- B. If any defects are found within the warranty period, the defective equipment shall be replaced at no cost; a one year warranty shall be provided for labor.

- C. Contactor shall respond, including weekends and holidays, within 24 hours to any warranty service calls. If equipment cannot be repaired within 24 hours of service visit, the Contractor shall provide "loaner" equipment to the facility at no charge.

*** END OF SECTION 28 05 00 ***

SECTION 28 31 11 - FIRE ALARM AND SMOKE DETECTION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire Alarm and Smoke Detection Systems.

1.2 RELATED SECTIONS

- A. Division 26, Building Wire and Cable, Boxes, Electrical Identification, etc.

1.3 REFERENCES

- A. The equipment and installation shall comply with the current provisions of the following codes and standards:
 - 1. NFPA 70—National Electrical Code.
 - 2. NFPA 72—National Fire Alarm Code.
 - 3. ANSI A117.1—American National Standard for Building and Facilities Providing Accessibility and Usability for Physically Handicapped People.
 - 4. NFPA 101—Life Safety Code.
 - 5. NEC Article 760—Fire Protective Signaling Systems.
 - 6. Americans with Disabilities Act.
 - 7. Florida Accessibility Code for Building Construction.
 - 8. Florida Fire Prevention Code.

1.4 REGULATORY REQUIREMENTS

- A. System: UL listed.
- B. Conform to requirements of NFPA 101.
- C. UL Listed—UL 1076.

1.5 SYSTEM DESCRIPTION

- A. Furnish, install, and place in operating condition an electronically-operated fire alarm system as described herein and shown in the plans. All units on the fire alarm system shall be listed by Underwriters' Laboratories, Inc. for fire alarm use, and the control panel shall bear the UL label. The system shall be installed in accordance with requirements set by National Electrical Code and in compliance with applicable provisions of Standard 72 published by the National Fire Protection Association (NFPA).

- B. Fire Alarm: The system shall be a microprocessor based point annunciated fire alarm system with walk-through test capability. The control panel and each individual component used in conjunction with the system shall be UL listed for its use. The system shall be totally supervised with a dynamic LCD display. The control panel shall also be able to monitor and receive analog signals from smoke and duct smoke detectors which indicate obscuration rate and set detector sensitivity. The input power shall be 120 volts, A/C 60 Hz connected per NFPA 72 and NEC. The operating power shall be single power source of 24 volts DC and filtered and regulated within 110% of the normal rating. Total power supply capacity shall be 50% greater than the total alarm load. The control panel shall be supervised on the input power line with automatic switch over to battery backup. The battery backup supply shall be capable of powering the system for at least 24 hours and still be capable of energizing all signal devices for a period of at least five minutes. Battery backup shall not be provided as a separate cabinet. Bypass switches shall be provided for gas and air handling unit shutdowns and door holders for alarm drills testing and servicing without the loss of equipment..
- C. System's Connection: The control panel shall be capable and wired so that any one or multiples of fire alarm devices, upon activation, shall sound alarm throughout the entire facility.
- D. Provide coordination with access control vendor to interface the Fire Alarm Control Panel (FACP) and the Access Control Panel for release of magnetic door locks when the FACP goes into alarm.
- E. Annunciator: A remote annunciator shall be provided capable of all the functions of the main fire alarm control panel including bypass switches for gas shutdown, AHU shutdown, and door holders.
- F. Sequence of Operation: Upon alarm activation of any area smoke detector, heat detector, manual pull station, or sprinkler waterflow; the following functions shall automatically occur:
 - 1. The internal audible device shall sound at the control panel.
 - 2. The alarm event shall display on the main control panel(s).
 - 3. The LCD display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location, and time/date.
 - 4. All system activities/events shall be documented on the system printer.
 - 5. Any remote or local annunciator LCDs or LEDs associated with the alarm zone shall be illuminated.
 - 6. All audible notification appliances shall operate throughout the facility. The audible notification appliances shall continue to sound until the alarm has been acknowledged.
 - 7. Simultaneously all visual strobes shall operate synchronously. The visual strobe shall continue to flash until the alarm has been acknowledged.
 - 8. A signal to the building automation system and to the central station with point identification shall be transmitted. Automatic smoke control sequences shall be activated.

9. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
10. All self-closing fire/smoke doors held open shall be released.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in smoke detection and fire alarm systems with five years documented experience.
- B. Installer: Company specializing in smoke detection and fire alarm systems with five years' experience, certified by Florida State Licensing Board as fire alarm and security system installing contractor.

1.7 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.
- B. Provide wiring diagrams, point to point with voltage drop calculations, data sheets, and equipment ratings, layout, dimensions, finishes, and battery calculations.
- C. Submit manufacturer's installation instructions under provisions of Division 1.
- D. Submit manufacturer's certificate under provisions of Division 1 that system meets or exceeds specified requirements, certification per NFPA 72.
- E. Provide training for two people on the operation, maintenance, and repair of the system at the Contractor's expense. Training shall be certified by the manufacturer and be at different times for each person. Include transportation, room and board where needed.

1.8 PROJECT RECORD DRAWINGS

- A. Submit documents under the provisions of Division 1.
- B. Include location of end-of-line devices.

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit data under provisions of Division 1.
- B. Include operating instructions, and maintenance and repair procedures, with parts list. Three copies of complete troubleshooting and repair manuals.
- C. Include manufacturer representative's letter stating that system is operational.
- D. Maintain system for a minimum of one year, after complete acceptance by the Owner, in accordance with NFPA 72.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 1.
- B. Store and protect products under provisions of Division 1.

1.11 EXTRA MATERIALS

- A. Provide spare parts under provisions of Division 1.

PART 2 PRODUCTS

2.1 BASIS-OF-DESIGN PRODUCT

- A. This system design constitutes the type and quality of equipment to be furnished.
 - 1. Acceptable Manufacturers:
 - a. Silent Knight.
 - b. Firelite.
 - c. Pre-Approved Equal.
- C. If equipment of another manufacturer is to be submitted for approval as equal, the Contractor shall, at the time of bid, list all exceptions taken to these Specifications, all variances from these Specifications, and all substitutions of operating capabilities or equipment called for in these Specifications and forward said list to the Engineer. Any such exceptions, variances, or substitutions which were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. Final determination of compliance with these Specifications shall rest with the Engineer, who, at his discretion, may require proof of performance.

2.2 FIRE ALARM CONTROL PANEL (FACP)

- A. Control panel construction shall be modular with solid state, microprocessor based electronics. It shall display only those primary controls and displays essential to operation during a fire alarm condition. Keyboards or keypads shall not be required to operate the system during fire alarm conditions.
- B. FACP shall operate from a 120 VAC input supply via emergency circuit panel (where available) and be capable of operating from a standby battery. It shall also provide 24 volt DC power for all control panel modules and supervised circuits.
- C. FACP shall be provided with bypass capability for gas valve, HVAC fan shut down, and magnetic door holder release for use during alarm drills, testing, and servicing without the loss of equipment.
- D. A local audible device shall sound during alarm, trouble or supervisory conditions. This audible device shall sound differently during each condition to distinguish one condition from another without having to view the panel. This audible device shall also sound during each keypress to provide an audible feedback to ensure that the key has been pressed properly.
- E. The following primary controls shall be visible through a front access panel:
 - ☐ Eighty character liquid crystal display.
 - ☐ Individual red system alarm LED
 - ☐ Individual yellow supervisory service LED.

- ☐ Individual yellow trouble LED.
 - ☐ Green "power on" LED.
 - ☐ Alarm acknowledge key.
 - ☐ Priority two alarm acknowledge key.
 - ☐ Supervisory acknowledge key.
 - ☐ Trouble acknowledge key.
 - ☐ Alarm silence key.
 - ☐ System reset key.
- D. The control shall provide the following:
- ☒ Setting of time and date.
 - ☒ LED testing.
 - ☒ Alarm, trouble, and abnormal condition listing.
 - ☒ Enabling and disabling of each monitor point separately.
 - ☒ Activation and deactivation of each control point separately.
 - ☒ Changing operator access levels.
 - ☒ Walk test enable.
 - ☒ Running diagnostic functions.
 - ☒ Displaying software revision level.
 - ☒ Displaying separate alarm and trouble logs.
 - ☒ Displaying card status.
 - ☒ Point listing.
 - ☒ Monitoring detector obscuration rate.
 - ☒ Setting of detector sensitivity.
- E. For maintenance purposes, the following lists shall be available from the point lists menu.
- ☒ All points listed by address.
 - ☒ Monitor point list.
 - ☒ Signal/speaker list.
 - ☒ Auxiliary control list.

- ☒ Feedback point list.
- ☒ Pseudo point list.
- ☒ LED/switch status list.
- ☒ Speaker silence switch.
- ☒ AHU shutdown override switch.
- ☒ Power supply current draw in alarm condition.
- ☒ Power supply current draw in standby condition.

2.3 DEVICES AND ACCESSORIES

- A. All devices on system shall be addressable. Addressable shall be defined as a smart device that is assigned an address in plain language for monitoring on the LCD and printer tapes and is field programmable by the Maintenance Personnel. All addressable devices shall have the capability of being disabled or enabled individually.
- B. Should a device fail, it will not hinder the operation of other system devices.
- C. All devices on system shall be supervised. A supervised system shall detect troubles in panel or wiring, removal or tampering of point devices, monitor either open or closed circuits, and verifies system integrity.
- D. The communication format must be a completely digital poll/response protocol to allow t-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol.
- E. Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact. Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel are unacceptable. These systems cannot accommodate t-tapping and the addition of an addressable device between existing devices requires reprogramming all existing electrically further devices. The system must verify that proper type device is in place and matches the desired software configuration.
- F. All addressable smoke and heat detector heads as specified below will be pluggable into their bases. The bases will contain electronics that communicate the detector status (normal, alarm trouble) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Different detectors heads (smoke or heat) must be interchangeable. Upon removal of the head, a trouble signal will be transmitted to the control panel. Auxiliary contacts shall be provided and wired to the elevator controller where shown as smoke detectors with elevated recall contacts.
 - 1. True Alarm Photoelectric Detector Head
 - a. The photoelectric type detector shall be a plug-in unit which mounts to a twist-lock base and shall be UL approved. Detector to provide an analog signal to the panel for monitoring of obscuration rate and maintenance of constant detector sensitivity.

- b. To minimize nuisance alarm, voltage and RF transient suppression techniques shall be employed as-well-as a smoke verification circuit and an insect screen. The detector design shall provide full solid-state construction and compatibility with other normally open fire alarm detection loop devices (heat detectors, pull stations, etc.). The detector head shall be easily disassembled to facilitate cleaning.
 - c. The detectors shall be of the solid state photoelectric type and shall contain no radioactive material. They will use a pulsed infrared LED light source and be sealed against rear air flow entry.
 - d. The detector shall fit into a verifiable type base that is common with both the heat detector and ionization type detector and shall be compatible with other addressable detectors, addressable manual stations and addressable zone adapter modules on the same circuit. The detector shall also fit into a non-addressable base that is capable of being monitored by an addressable zone adapter module.
 - e. There shall be no limit to the number of detectors or zone adapter modules which may be activated or in alarm simultaneously. The operating voltage shall be 24 VDC and operate on a supervised loop.
 - f. The control panel shall maintain a moving average of the sensors' smoke chamber value to automatically compensate for duct and dirty conditions that could affect detection operations. The adjustable level shall be between 0.2% and 3.7% smoke obscuration.
 - g. The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined value, a "DIRTY SENSOR" trouble condition shall be audibly and visually indicated at the control panel. Additionally, the LED on the sensor base shall glow steady. If a "DIRTY SENSOR" is further contaminated, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control panel.
 - h. The control panel shall continuously perform an automatic self-test routine on each sensor to ensure the accuracy of the values being transmitted to the control panel by the sensor. Any problem with the self-test shall be indicated by a "SELF TEST ABNORMAL" trouble condition at the panel.
 - i. Each sensor shall be capable of being individually set for percent smoke, time of day for percent, and multiple threshold settings.
2. Addressable Pull Stations
- a. Addressable pull stations will contain electronics that communicate the station's status (alarm, normal) to the transponder over two wires which also provide power to the pull station. The address will be set on the stations. They shall be manufactured from ABS plastic with raised white lettering and a smooth high gloss finish. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks. Pull stations shall be normally open, single action manual stations.

- b. The front of the station is to be hinged to a backplate assembly and must be opened with a key to reset the station. The key shall be common with the control panels. Stations which use Allen wrenches or special tools to reset will not be accepted.
 - c. The addressable manual station shall be capable of field programming of it's "address" location on all addressable initiating circuit. The manual station shall be fitted with screw terminals for field wire attachment.
 - d. There shall be no limit to the number of stations, detectors, or zone adapter modules, which may be activated or in alarm simultaneously.
- 3. Automatic Heat Sensor
 - a. Device shall be combination rate-of-rise/fixed temperature sensor of which both operations are self-restoring. The temperature shall be field selectable. Auxiliary contacts shall be provided and wired to the elevator controller where shown as heat detectors with elevator shunt trip contacts.
- 4. Speakers
 - a. The speakers shall be polarized and shall be operated by 24 VDC. Each speaker assembly shall include separate wire leads for in/out wiring for each leg of the associated signal circuit. T-tapping of signal device conductors to signal circuit conductors shall not be accepted. The alarm speakers shall be suitable for rear mounting behind audio-visual assemblies which shall be flush mounted with AV backboxes and flush trim ring. The white Lexan lens shall have the words 'FIRE' in red lettering on the sides and shall be pyramidal in shape to allow for side viewing. All outdoor alarm signals shall be speaker only, mounted a minimum of 8' above grade in a weatherproof box.
 - b. Minimum dB: 87 dB at 10 feet not to exceed 120 dba.
- 5. Low Frequency Sounder and Sounder Strobes (reference drawings for locations)
 - a. The low frequency sounder shall comply with NFPA 72 for sleeping areas. It shall operate on 24 VDC (fully synchronized-provide module as required), shall be UL 464 listed, and shall be approved for fire protective service. The low frequency sounder shall be powered from a notification appliance circuit output. The low frequency sounder shall have an option to switch between temporal three pattern, non-temporal (continuous) pattern, and coded supply within the frequency range of 520Hz $\pm$ 10% square wave tone. The low frequency sounder shall operate on a coded or non-coded power supply.

- b. The low frequency sounder strobe shall comply with NFPA 72 for sleeping areas. It shall be fully synchronized – provide module as required, shall be UL 1971 and UL 464 listed, and shall be approved for fire protective service. The low frequency sounder strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The sounder shall have an option to switch between a temporal three pattern and a non-temporal (continuous) pattern. These options shall be set by a multiple position switch. The field selectable tones shall sound within the frequency range of 520 Hz $\pm$ 10% square wave tone. The low frequency sounder on low frequency sounder strobe models shall operate on a non-coded power supply.
- 6. Visual Flashing Lamps (Xenon Strobe)
 - a. Visual indicating appliances shall be comprised of xenon flashtube and be entirely solid state. These devices shall be UL listed and be capable of either ceiling or wall mounting. The Lexan lens shall be pyramidal in shape to allow better visibility. Separate alarm indicating circuits shall be provided for strobes. The maximum strobe pulse duration shall be 0.2 seconds with a maximum duty cycle of 40 percent. The flash rate shall be at least 1 Hz but not to exceed 2 Hz. Strobes shall be provided in accordance with the latest applicable version of NFPA 72 and the candela rating of strobes provided shall be sized to meet the room requirements. All visual alarms shall be mounted 80 inches above the finished floor, or six inches below the ceiling, whichever is lower. All visual indicating appliance output levels will be sized per NFPA 72, Chapter 6. Submitted shop drawings shall show output levels per each strobe.
- 7. Combination Alarm Unit
 - a. Provide Manufacturer's heavy duty construction combination speaker and strobe (white lens) unit. Speakers shall be listed for fire alarm use by Underwriter's Laboratories, Inc. The alarm signals shall be semi-flush mounted at the locations indicated on the plans. All outdoor alarm signals shall be horn only, mounted in a weatherproof box. All alarms shall be intermittent.
 - b. All audible alarms must be 15 dba above ambient or exceed any maximum sound level for 60 seconds by 5 dba, whichever is louder. Sound levels not-to-exceed 120 dba.
- 8. Duct Detector
 - a. Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Detector shall include relays as required for fan shutdown.
 - b. The addressable duct smoke sensors shall operate on the light scattering, photo-diode principle, and shall communicate actual smoke chamber values to the system control. The sensors shall not have a self-contained smoke sensitivity setting and shall automatically communicate actual smoke chamber values to the system control unit. The sensor's electronics shall be shielded to protect against nuisance alarms from EMI and RFI.

- c. The duct housing shall provide an auxiliary alarm relay with two "Form C" contacts rated at 2A @ 28 VDC or 120 VAC resistive. This auxiliary relay operates when the sensor reaches its alarm threshold, or when the control unit via software control, manually or automatically operates the relay in response to inputs from other devices.
- d. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
- e. Each duct detector shall have a Remote Test Station with an alarm LED and test switch. Locate all test stations in mechanical rooms serving same and label all stations with an affixed nameplate indicating AHU number and supply/return as applicable.

2.4 NETWORK

- A. The system must provide communication with initiating and control devices individually, and other control panels. All of these devices will be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:
 - 1. Alarm
 - 2. Trouble
 - 3. Open
 - 4. Short
 - 5. Device missing/failed
- B. All addressable devices shall have the capability of being disabled or enabled individually.
- C. Up to 127 addressable devices may be multi-dropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.
- D. The communication format must be a completely digital poll/response protocol to allow t-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol.
- E. Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact. Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel are unacceptable. These systems cannot accommodate t-tapping and the addition of an addressable device between existing devices required reprogramming all existing electrically further devices. The system must verify that proper type device is in place and matches the desired software configuration.

2.5 REMOTE ANNUNCIATOR PANEL (FARA)

- A. Where shown on the plans, provide and install a serial LED annunciator. The annunciator(s) shall have a beige enamel finish and shall provide one alarm lamp and one trouble lamp per initiation device circuit. The annunciator shall communicate to the control panel over one twisted shielded pair of wire and operating power shall be 24 VDC and be fused at the control panel and emulate all of the control/annunciation functions of the control panel.
- B. The serial annunciator shall provide a common alarm and trouble circuit consisting of, but not limited to, the following:
 - 1. Control pushbutton switches for: alarm silence, trouble silence, system reset, and manual evacuation duplicating the control panel switches. A key "enable" switch shall be provided to activate or deactivate the control switches.
 - 2. Tone Alert—Duplicates the control panel tone alert during alarm and trouble conditions.
 - 3. System trouble LED.
 - 4. Power ON LED.

2.6 COMMERCIAL-GRADE, DUAL PATH COMMUNICATOR

- A. Provide universal, LTE cellular and IP commercial fire alarm communicator compatible with Owner's carrier. Provide in metal enclosure and mount above FACP. Device shall be panel supported and compliant with UL 864 (current edition), NFPA 72, CSFM, NYCFD, and LAFD. Contractor shall connect communicator to Owner's account or central station, as directed by the Owner. Contractor shall test communications.
- B. Acceptable Manufacturer: NAPCO StarLink SLETEVI-CFB-PS (V for Verizon but Contractor shall confirm carrier with Owner prior to ordering). Provide extended-range Universal StarLink Omni™ Indoor/Outdoor cell antennas, if needed for signal.

2.7 BATTERY BACK-UP

- A. The system shall be battery back-up for 24 hours with five minutes of alarm capabilities (per NFPA 72).

2.8 LIGHTNING PROTECTION

- A. Provide Isolated Loop Circuit Protectors.
- B. Provide lightning protection at all points entering and leaving each building and at the FACP and FATC locations shown on drawings. (EDCO)
- C. Loop protection shall be manufactured and listed for use with the fire alarm system.
- D. Provide AC surge protection on power feeding the panel.

PART 3 EXECUTION

3.1 INSTALLATION OF FIRE ALARM SYSTEM

- A. Install fire alarm system as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECAs "Standard of Installation."
- B. Wiring Systems and Materials
 - 1. Wiring shall be in accordance with requirements of the National Electrical Code and NFPA Regulation 72. The fire alarm system, including components and wiring shall be completely installed and wiring shall be properly tagged and color coded. The Electrical Contractor shall make final connections as shown and required by the equipment manufacturer's wiring instructions.
 - 2. Use 14 AWG minimum size conductors for fire alarm detection/initiating and signal circuit conductors. Install wiring in conduit along with continuous ground wire. Provide wiring of adequate size to prevent voltage drop. Submit load calculations for each signal circuit and zone circuit indicating actual voltage drop and proper size conductors.
 - 3. Color Code—the color codes of the fire alarm cabling shall conform with the following:
 - a. Speaker—Red (+) and Black (-).
 - b. Pull Station/Heat/Smoke Detector—Blue and Yellow.
 - c. Fan Shut-down/Door Release—White.
 - d. Visual Flashing Lamps—Purple and Orange.
 - 4. All junction box covers shall be painted red and all lengths of conduit shall have at least one red stripe.
 - 5. Shutdown relays and control equipment shall be mounted within three feet of controlled device. Label all fan shutdown relay modules with an affixed nameplate. Relays to be located directly adjacent to motor starters.
 - 6. Visual flashing lamps shall be wired on a separate circuit from speakers and other indicating and initiating devices.
 - 7. Speaker and strobe appliance circuits shall be loaded a maximum of 70% of the circuit's operating capacity.
 - 8. Power supplies to be provided with a minimum 30% spare capacity.

3.2 QUALITY ASSURANCE

- A. NEC Compliance—Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories.
- B. UL Compliance and Labeling—Provide fire alarm and detection system components which are UL listed and labeled. Installation is to be by a UL listed installer.

- C. Miscellaneous Compliance—The fire alarm system is to be installed in accordance with the equipment manufacturer's written instructions and complying with all applicable portions of the NECAs "Standard of Installation" and all local codes and ordinances.

3.3 FIELD QUALITY CONTROL

- A. Inspect relays and signals for malfunctioning, and where necessary adjust units for proper operation to fulfill project requirements. Any final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of fire alarm and detection system equipment. The Manufacturer's representative shall perform a quality inspection of the final installation and, in the presence of the Electrical Contractor, fire marshal and Owner's Representatives, shall perform a complete functional test of this system. A system certification verifying the proper system operation shall be required prior to acceptance by the Owner.
- B. Testing: The Contractor shall perform all electrical and mechanical tests required by the equipment manufacturer's form and National Fire Protection Association Standard 72. All test and report costs shall be in the contract price. A checkout report shall be prepared by the installation technicians and submitted in triplicate, one copy of which will be registered with the equipment manufacturer. The report shall include, but not be limited to:
 - 1. A complete list of equipment installed and wired.
 - 2. Indication that all equipment is properly installed and functions and conforms with these specifications.
 - 3. Tests of individual zones, as applicable.
 - 4. Serial numbers, locations by zone and model number for each installed detector.
 - 5. Response time on thermostats and flame detectors (if used).
 - 6. Technician's name, certificate number and date.
 - 7. Voice Evacuation Speaker Audible Intelligence Testing: This test shall be accomplished with audible intelligence meter on a 10 foot by 10 foot grid over the entire floor space of the areas covered by voice evacuation. All readings shall exceed the equivalent of a Common Intelligibility Scale (CIS) score of 0.70. These grid locations and readings shall be recorded in a graphic document and shall be included in the overall fire alarm testing report package.
- C. Documentation: After completion of the tests and adjustments listed above, the Contractor shall submit the following information to the Owner.
 - 1. A copy of the test report described in this specification and a Certificate of Compliance prepared as per National Fire Protection Association Standard 72 Chapter 2, Section 2-2.4, and State Fire Marshal's Rule 4A-48 to be complete at final test.
 - 2. Affixed to FACP a standard service tag, as described in rule 4A-48 for fire alarm contractors by the Office of the State Fire Marshal.
 - 3. Final tests and inspection shall be held in presence of the Owner and Engineers' representatives and to their satisfaction. The Contractor shall supply personnel and required auxiliary equipment for this test without additional cost.

4. To assure that wire size, power supply, number of devices on a circuit, etc. are suitable to support 100% of devices being in alarm or operated simultaneously, this test shall include the following:
5. Place all sensors and monitor modules in alarm. Each shall display it's address or zone and alarm condition. At least the first five devices on each circuit shall also have their alarm LEDs lighted.
6. Operate all control modules for the alarm or operated condition. Each module shall display it's address and condition.
7. Reset all alarmed and operated devices. The panel shall display the address or zone of any off-normal devices.
8. Test a representative number of sensors for alarm verification by momentarily testing for alarm. The sensor shall not initiate an alarm. Then, test by placing the sensor in alarm such that it remains in alarm for the selected verification time. The sensor shall initiate an alarm.
9. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a 90 day test period without any unwarranted alarms. Should unwarranted alarm(s) occur, the Contractor shall readjust or replace the detector(s) and begin another 90 day test period. As required by the Engineer, the Contractor shall recheck the detectors using the fire test after each readjustment or replacement of detectors. This test shall not start until the Owner has obtained beneficial use of the building under tests.
10. If the requirements provided in the paragraph above are not completed within 30 days after beginning the tests described therein, the Contractor shall replace the system with another acceptable manufacturer and the process repeated until acceptance of the equipment by the Owner.
11. The Contractor shall provide three sets of signed and sealed submittals to be accepted upon the Engineer's approval.
12. A statement of guarantee including date of termination and name and phone number of the person to be called in the event of equipment failure.
13. Individual factory issued manuals containing all technical information on each piece of equipment installed. In the event that such manuals are not obtainable from the factory, it shall be the responsibility of the Contractor to compile and include them. Advertising brochures or operational instructions shall not be used in lieu of the required technical manuals.
14. One copy of all approved shop drawings, instruction sheets, operating instructions, and spare parts bulletins.
15. A training session, for personnel selected by the Owner, shall be presented by a fully qualified, trained representative of the equipment manufacturer who is thoroughly knowledgeable of the specific installation.
16. Provide a written description of standard control panel functions and user instructions at each FACP. These instructions shall be written in standard laymen's English so that an unfamiliar operator can accomplish basic functions such as reset.

3.4 LIGHTNING PROTECTION

A. Isolated Loop Circuit Protector (ILCP)

1. Furnish and install an isolated loop circuit protector device on all fire alarm (initiating device circuit), (signaling line circuit), (audio riser), (telephone riser or circuit) wiring, (including shields), which extends beyond the main methods (walkways, bridges, or other above ground connectors).
2. The ILCP shall be located as close as practical to the point at which the circuits leave or enter a building.
3. The ILCP grounding conductor shall be a No. 12 AWG wire having a maximum length of 28 feet to be run in as straight a line as practical and connected to a building ground electrode system (unified ground) per the (1987) National Electrical Code.
4. The ILCP furnished shall have a line to line response time of less than one nanosecond capable of accepting greater than 2,000 amps (35 joules each line) to earth. Shield to earth current shall be 5,000 amps maximum.
5. The ILCP shall be protected by a high dielectric insulating material and of small enough size to mount in a standard 4" square 2-1/8" deep electrical box.
6. Spark gap devices or devices incorporated in or installed within the fire alarm control panel in lieu of the specified ILCP are not acceptable.

B. Provide Ditek DTK Series or equivalent Isolated Loop Circuit Protectors.

3.5 SYSTEM GUARANTEE

- A. All components, parts, and assemblies supplied by the Manufacturer shall be guaranteed against defects in materials and workmanship for a period of 12 months commencing the date of Final Acceptance by the Fire Department or Substantial Completion, whichever is later. Warranty service shall be provided by a qualified factory-trained representative of the equipment manufacturer during normal working hours. The representative must be able to respond to warranty calls within 12 hours, including weekends, of notice whether oral or written.
- B. Provide, within one year after final acceptance, testing as per National Fire Protection Association 72, which shall consist of:
 1. Regularly and systematically examine, adjust and clean all the electrical and mechanical components of waterflow switches, as required by code.
 2. Test and Written report which certify that all initiating devices have been tested and which indicate the result of the inspection.

*** END OF SECTION 28 31 11***

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SECTION 31 1000 - DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. The work covered by this Section of the specifications consists of furnishing all material, labor, tools, equipment, plant, appliances and services necessary to complete all demolition and relocation work required in the Drawings and specified herein. The CONTRACTOR shall examine the various Drawings, visit the site and determine for himself the extent of the work, the extent of work affected therein and all conditions under which he is required to perform the various operations.
- B. Existing site structures and appurtenances affected herein are indicated generally on the Construction Plans.

1.3 QUALITY ASSURANCE

- A. Permits and Licenses: CONTRACTOR shall obtain all necessary permits and licenses for performing the work and shall furnish a copy of same to the OWNER prior to commencing the work. The CONTRACTOR shall comply with the requirements of the permits.
- B. Notices: CONTRACTOR shall issue written notices of planned demolition to companies or local authorities owning utility conduit, wires or pipes running to or through the project site. Copies of said notices shall be submitted to the Engineer.
- C. Utility Services: CONTRACTOR shall notify utility companies or local authorities furnishing gas, water, electrical, telephone or sewer service to remove any equipment owned by them in structures to be demolished and to remove, disconnect, cap or plug their services to facilitate demolition.

1.4 JOB CONDITIONS

- A. Sequence of Construction: Demolition, removal and relocation work shall be coordinated with the OWNER and an agreed upon sequence of construction to minimize down time at the site.

1.5 DISPOSITION OF DEMOLISHED MATERIALS

- A. Salvaged materials designated as property of the OWNER shall be stored in areas designated by the OWNER. The CONTRACTOR shall promptly remove all other materials from the site.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. SALVAGE:
 - 1. Material to be salvaged shall be removed with the minimum amount of damage and stored on the site as directed by the OWNER. Material stored on the ground shall be placed on blocks, and all stored material shall be stacked and placed in an orderly manner. Salvaged equipment and materials which can be damaged by the weather shall be stored in a weather-tight building or area on site until removed by the CONTRACTOR. Any salvaged items that are determined to be of no value to the OWNER after removal and OWNER's inspection, shall be removed from the site by the CONTRACTOR.

3.2 PERFORMANCE

- A. General: Demolition shall result in the complete removal and disposal of existing structures and appurtenances from the site as indicated on Drawings, the salvaging of indicated items and the cleanup after completion of the demolition work.
- B. MODIFICATIONS:
 - 1. The cutting and removal of existing work necessary for modifications and installation of new work shall be made with a minimum of damage to the work that is to remain. Any damage done to existing facilities which are to remain shall be repaired at the CONTRACTOR's expense to the satisfaction of the OWNER.
 - 2. Debris created within facilities, which are to remain in service during the modification work, shall be removed at the end of each day's operation.
 - 3. The CONTRACTOR shall follow other specific instructions for the modification work given in other Sections of these specifications and as shown on the Drawings.

3.3 CLEANUP

- A. Site shall be left in a clean condition satisfactory to the OWNER and the ENGINEER OF RECORD, free from demolished materials, rubbish or debris. Site shall be graded to meet adjacent contours and provide flow for surface drainage.
- B. The CONTRACTOR shall restore items intended to remain that have been damaged by demolition work.
- C. All interrupted utility services shall be returned to their pre-existing state and disconnect temporary services, unless otherwise specified.

END OF SECTION

SECTION 31 1100 - CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. SCOPE

This Section includes all clearing and grubbing work indicated on the Plans and as required, complete with cutting and removal of trees, shrubs, vegetation, stumps, logs, brush, roots and undergrowth, the removal of pavement, underdrains, underground utilities, and the disposal of materials.

B. RELATED WORK SPECIFIED ELSEWHERE

- 1. General Earthwork: Section 31 2000
- 2. Site Grading: Section 31 2200
- 3. Earthwork for Paving: Section 31 2216

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTIONS

3.1 EXECUTION OF WORK

A. GENERAL

- 1. Areas designated for improvements on the Plans shall be cleared of all trees, shrubs, vegetation, stumps, logs, brush, roots, buildings, concrete foundations, underdrains, underground utilities, and debris.

- 2. Clearing and Removal

Within areas for roadways, sidewalks, and parking areas where the finished grade is five (5) feet or less in height above the existing ground, trees, stumps, and roots shall be removed to a depth of not less than 12 inches below the existing ground. Within areas for roadways sidewalks, and parking areas, where the finished grade is more than five (5) feet in height above existing ground, trees and stumps shall be cut off flush with the existing ground surface. For embankment areas outside of the roadways, sidewalks, and parking areas, trees and stumps shall be cut off flush with the existing ground surface, or as indicated on the Plans or as directed by the ENGINEER OF RECORD.

Within areas designated for a building pad the trees; stumps, roots, vegetation and other debris shall be removed completely. Within areas designated for buildings and training fields the existing trees, stumps, roots, buildings, concrete foundations, underdrains, underground utilities, etc. shall be removed to a depth of not less than 3 feet below existing grade.

- 3. Removal of Trees, Stumps, and Other Vegetation

Where trees cannot be felled without danger to traffic or injury to other trees, structures or property, they shall be cut down in Sections. The removal of stumps and roots may be accomplished by the use of a shredding machine meeting the approval of the ENGINEER OF RECORD.

All logs, stumps, poles, brush, and other unsatisfactory material occurring in the Contract Limits shall be removed and shall be disposed of by the CONTRACTOR. Material shall be disposed of outside of the Contract Limits as specified in Section 312000, General Earthwork.

4. Holes and Trenches

All holes and trenches remaining after the grubbing operation in embankment areas shall have the sides broken down or leveled, and shall be refilled with acceptable material. The material shall be moistened and properly compacted according to the minimum standards outlined in the specifications in layers by tampers or rollers to the density required under roadways, parking areas, and other special areas. The same construction procedure shall be applied to all holes and trenches remaining in excavation areas where the depth of holes exceeds the depth of proposed excavation.

END OF SECTION

SECTION 31 2000 - GENERAL EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. SCOPE

This Section includes general earthwork complete with: preserving topsoil; removal and disposal of structures and obstructions; protection of existing sewers; tiles and mains; protection of existing building and improvements; protection of trees and other types of vegetation; protection of utility lines; requirements for pavement replacement; restoration of driveways and parking areas; restoration of sidewalks; restoration of lawns and disturbed areas; soil erosion and sedimentation control; and removal, transportation, and disposal of excess excavation.

B. Related Work Specified Elsewhere

- 1. Dewatering: Section 31 2319
- 2. Bituminous Paving: Section 32 1113

1.3 QUALITY ASSURANCE

A. Reference Standards

Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

Florida Department of Transportation (FDOT)

Hillsborough County Technical Specifications

Southwest Florida Water Management District

B. Requirements of Regulatory Agencies

The CONTRACTOR, at his expense, shall prepare all plans, obtain all approvals, secure all permits, and post all bonds or deposits required to comply with PART IV, Chapter 373 Florida Statutes (F.S.), the Florida Environmental Land and Water Management Act of 1972 (380.012 F.S. et seq.), and related statutes.

1.4 SUBMITTALS

A. Reports

- 1. Written permission for the use of all disposal and borrow sites shall be obtained and copies shall be furnished to the OWNER and the ENGINEER OF RECORD.

1.5 JOB CONDITIONS

A. Protection

- 1. Protection of Plant Life

All trees, shrubs, and other types of vegetation not within the limits of the Work or not

designated on the Plans or by the ENGINEER OF RECORD to be removed, shall be carefully protected from damage or injury during the various construction operations. Any tree, shrub or other type of vegetation not designated to be removed but which is damaged by the CONTRACTOR'S operation shall be repaired or replaced by the CONTRACTOR, at his expense, as directed by the OWNER or the ENGINEER OF RECORD. A STAGING PLAN SHALL BE SUBMITTED BY THE CONTRACTOR.

2. Protection of Existing Structures and Improvements

All existing culverts, sewers, drainage structures, manholes, water gate wells, hydrants, water mains, utility poles, overhead lines, underground conduits, underground cables, pavement, or other types of improvements within the construction limits, not designated on the Plans or directed by the ENGINEER OF RECORD to be removed, shall be carefully protected from damage during the construction operations.

Any type of existing structure or improvement not designated to be removed, but which is damaged by the CONTRACTOR'S operations shall be repaired or replaced by the CONTRACTOR, at his expense. THE CONTRACTOR SHALL SURVEY THE EXISTING SITE AND SHALL REPORT TO THE OWNER AND THE ENGINEER OF RECORD ANY PRE-EXISTING DAMAGE TO THE SITE INFRASTRUCTURE OR IMPROVEMENTS.

B. Maintaining Drainage

All existing open drains, field and roadway ditches, drainage tile, sewers, enclosed drains, natural and artificial watercourses, surface drainage or any other types of drainage within the limits of the Work shall be maintained and free to discharge during the excavating, backfilling and compacting operations.

Any drainage facility not designated to be abandoned, but which is damaged, and/or any drainage interrupted by the CONTRACTOR'S operation shall be immediately repaired, replaced, or cleared by the CONTRACTOR, as directed by the ENGINEER OF RECORD. All costs incurred shall be incidental to the excavating, backfilling and compacting or grading operations.

1.06 GUARANTEE

Existing trees destroyed by neglect of the CONTRACTOR or his subcontractor's, will be replaced by the CONTRACTOR. Replacement of tree species and location shall be determined by the OWNER

PART 2 - PRODUCTS

2.1 MATERIALS

Granular material shall conform to the Hillsborough County Technical Specifications for Sanitary Sewers, attachment #9 Backfill Specifications. Granular material shall be material within the following gradation limits, passing a No. 4 sieve-95% (min) passing a No. 200 sieve - 5% (max) and meeting the approval of the ENGINEER OF RECORD.

PART 3 - EXECUTION

3.1 PREPARATION

A. General

The CONTRACTOR and the OWNER shall meet before commencement of site clearing to discuss locations of top soil spoils, construction circulation and materials storage in relation to the preservation of existing plant materials. This meeting shall be requested by the CONTRACTOR two (2) weeks prior to site clearing operations commence. THE CONTRACTOR'S STAGING PLAN SHALL BE SUBMITTED PRIOR TO THE SCHEDULING OF THIS MEETING.

B. Dewatering

The area within the vicinity of the new Work shall be dewatered prior to commencing any construction activities. The depth of the dewatering shall be sufficient to allow the Work area to remain in a dry

condition during the various construction operations. The costs incurred for furnishing, installing, maintaining and removing the dewatering equipment shall be at the CONTRACTOR'S expense. See Section 312319 for additional specifications

3.2 PERFORMANCE

A. General

The various construction operations shall be restricted to the areas indicated on the Plans. If additional area is required, the CONTRACTOR shall furnish the OWNER with written permission obtained from the property owner for any part of the operations he conducts outside of the limits indicated on the Plans. Barriers shall be installed in locations as directed by the ENGINEER OF RECORD or governing agency having such authority.

B. Existing Topsoil On-Site

Topsoil encountered along the route of the construction shall be pushed back and preserved for use in restoration following completion of the construction. The topsoil must remain on the project site during construction.

C. Existing Utilities

When existing utilities are shown on the Plans, their locations are approximate only, as secured in the field investigation and from available public records. The CONTRACTOR, prior to the start of construction, shall contact Sunshine One Facilities Locating Service and/or the public agency or utility having jurisdiction to request the verification of all utilities within the construction area.

When existing utility lines, structures or utility poles are encountered during the performance of the Work, the CONTRACTOR, at his expense, shall perform his operations in such a manner that the service will be uninterrupted.

The CONTRACTOR shall expose all existing utility lines prior to any excavation operation, to determine any conflict with the proposed improvement. The CONTRACTOR shall be responsible for any relocation required as a result of any conflict of existing utilities with the proposed improvement.

Should it become necessary to move any utility structure, line or pole, whether called for on the Plans or otherwise found necessary to be moved, the CONTRACTOR shall make all arrangements with the specific utility for the moving. All costs incurred for such moving shall be at the CONTRACTOR'S expense unless indicated otherwise. However, before disturbing a utility line, structure or pole, the CONTRACTOR shall furnish the OWNER with satisfactory evidence, in writing, that proper arrangements have been made with the Owner of the utility.

D. Existing Sewers, Tile and Mains

Existing sanitary sewers, storm sewers, drain tile, septic tank bed tiles, water mains or building services or leads, that are encountered during the performance of the Work that require relocation or are damaged, shall be restored with new materials equal in quality and type to the materials encountered.

The new material shall be installed as specified on the Plans or as directed by the ENGINEER OF RECORD. The bedding and backfill material, unless otherwise specified, shall be an approved granular material, compacted to 95% of its maximum unit weight.

Seepage bed tile and water mains shall be replaced in accordance with the requirement of the appropriate local Department of Health.

The relocation or protection of existing sewers, tiles, tile field, water mains or building services and leads shall be at the CONTRACTOR'S expense, unless otherwise indicated in the Contract Documents.

F. Existing Structures

Existing surface and subsurface structures may be shown on the Plans, in locations considered most

probable from information secured in the field investigation and from available public records. Neither the correctness nor completeness of such information is guaranteed or implied. All structures shall be protected, preserved, restored, or removed by the CONTRACTOR, at his expense, as directed by the Plans or by the ENGINEER OF RECORD.

Unless otherwise specified on the Plans, CONTRACTOR at his expense, shall remove any abandoned culvert, pipe, sewer, structure or part of a structure which is to be replaced or rendered useless by the new construction.

The structure shall be broken down to at least 12 inches below the subgrade. All pipes connected to the structure shall be plugged with a brick, masonry or concrete bulkhead, approved by the ENGINEER OF RECORD. The remainder of the excavation shall be backfilled with a granular material, compacted in place, and shall meet with the approval of the ENGINEER OF RECORD.

If a structure is to be removed from a system that is to remain in service, a bypass system, approved by the OWNER and the ENGINEER OF RECORD shall be installed and maintained by the CONTRACTOR, during the rebuilding period.

Salvaged materials derived there from shall become the property of the CONTRACTOR and unless otherwise specified on the Plans or in the Summary of Work shall be disposed of by the CONTRACTOR, at his expense.

G. Trees

All trees excepting those specified on the Plans to be removed shall be effectively protected by the CONTRACTOR during his construction operations. Individual trees to be preserved shall have tree protection barriers installed at the drip line of each tree.

H. Fences

Fences shall be removed and replaced or shall be removed as indicated on the Plans. If any of the existing material is damaged or destroyed, the CONTRACTOR shall replace the material at his expense.

Where fencing is encountered during construction, and its removal was not called for on the Plans or was not directed by the OWNER OR DESIGNATED REPRESENTATIVE, it shall be replaced or restored, at the CONTRACTOR'S expense, to a condition comparable to that prior to construction. All temporary construction fencing shall be maintained in good condition during the construction. After the fence removal or relocation operations are complete, all surplus material shall be removed and disposed of by the CONTRACTOR, at his expense, unless otherwise called for on the Plans.

Any holes or voids resulting from the fence removal operation shall be backfilled with a suitable material, approved.

Where fences are encountered that are being used to provide security and pedestrian control, the same shall be immediately replaced following the disturbance. During the disturbance, the CONTRACTOR, at his expense, shall provide, install and maintain a temporary fence, meeting the approval of the OWNER.

I. Removing Pavement

The removal of concrete and bituminous pavement as called for on the Plans or as directed by the Engineer/Consultant, shall consist of removing and disposing of pavement and shall include base courses, surface courses, integral and separate curbs, integral and separate curb and gutters, sidewalks and end headers.

The pavement shall be removed to an existing joint or cut to a true line, either perpendicular or parallel to the direction of travel, with the vertical face resting a minimum of 18 inches onto undisturbed ground, as indicated on the Plans, or as directed by the ENGINEER OF RECORD. The cutting shall be accomplished by using a power driven concrete saw, approved by the ENGINEER OF RECORD. The depth of the saw cut shall be a minimum of six (6) inches, or as directed by the ENGINEER OF RECORD, to insure that the removal of the old pavement will not disturb or damage the Section of

pavement remaining in place.

Residual concrete pavement shall not be less than five (5) feet measured transversely, nor less than six (6) feet longitudinally measured from a joint.

In removing a concrete base course, where part of the existing bituminous surface is to remain in place, the bituminous surface shall be cut the full depth by the use of a power driven saw, approved by the ENGINEER OF RECORD along a line parallel to and at least one (1) foot from either side of the base course removal.

Old pavement with a concrete cap shall be considered as only one pavement, whether or not there is a separation layer of earth, aggregate, or bituminous material between the old material and the concrete cap.

Where integral curb is to be removed flush with the existing concrete pavement, the operation shall be performed by saw cutting or by a mechanical means, approved by the ENGINEER OF RECORD, so as to leave a neat and flush cleavage plane, without damage to the underlying pavement.

Where integral curb and gutter are to be removed, the operation shall be performed by saw cutting. The limits of the removal shall be as called for on the Plans or as directed by the ENGINEER OF RECORD. However, in no case shall the width of removal be less than 18 inches for Sections with rolled or straight curb or less than 24 inches for mountable curbs.

If during the pavement removal operation any concrete or bituminous pavement or surfacing is damaged beyond the removal limits designated on the Plans or directed by the ENGINEER OF RECORD, the damaged pavement or surfacing shall be removed and replaced at the CONTRACTOR'S expense subject to approval and acceptance of the OWNER and the ENGINEER OF RECORD.

Any earth which may be removed during the pavement removal operation shall be replaced by backfilling to the proposed subgrade with a suitable material, approved by the ENGINEER OF RECORD, at the CONTRACTOR'S expense.

J. Guardrail

Beam guardrail and cable guardrail shall be relocated or shall be removed as specified on the Plans or as directed by the ENGINEER OF RECORD. If any of the existing material is damaged or destroyed, the CONTRACTOR shall replace the material at his expense.

Where guardrail is encountered during construction, and its removal was not called for on the Plans or was not directed by the ENGINEER OF RECORD, it shall be replaced or restored, at the CONTRACTOR'S expense, to a condition comparable to that prior to construction. After the guardrail removal or relocation operations are complete, all surplus material shall be removed and disposed of by the CONTRACTOR, at his expense, unless otherwise called for on the Plans or as directed by the ENGINEER OF RECORD.

Any holes or voids resulting from the guardrail removal operation shall be backfilled with a suitable material approved by the ENGINEER OF RECORD.

K. Adjust Structures

Structures to be adjusted shall be as called for on the Plans, or as directed by the ENGINEER OF RECORD. Adjustment of structures shall apply where the elevation of the casting is either raised 12 inches or less, or lowered six (6) inches or less.

The existing frame and cover shall be carefully removed and stored, and shall be reinstalled on the same structure, unless a new frame and cover are called for on the Plans. The brick or concrete adjustment rings shall be set in mortar or installed as recommended by the manufacturer.

The outside surface of the new brick or block structures shall receive a masonry plaster coat, a minimum of 2 inch thick.

The structure shall be properly backfilled with a granular material, compacted in place and meeting the approval of the ENGINEER OF RECORD.

The flow in the entire system shall be maintained, at the CONTRACTOR'S expense, while performing any part of the Work. Also, the structure shall be cleaned and all unsuitable material shall be disposed of at the CONTRACTOR'S expense.

L. Reconstruct Structures

Structures to be reconstructed shall be as called for on the Plans or as directed by the ENGINEER OF RECORD. Reconstruction of structures shall apply where the elevation of the casting must be raised in excess of 12 inches or lowered in excess of six (6) inches.

The existing frame and cover shall be carefully removed and stored, and shall be reinstalled on the same structure unless a new frame and cover are called for on the Plans, or as directed by the ENGINEER OF RECORD.

The existing corbel entrance Sections or precast concrete chimney type entrance shall be removed along with any additional brick courses or precast concrete Sections necessary to achieve the amount of reconstruction called for on the Plans, or as directed by the ENGINEER OF RECORD. The necessary brick Work and precast concrete Sections shall be installed to meet the design grade.

Manhole steps shall be furnished and shall be installed, as necessary, to comply with the Plans, or as directed by the ENGINEER OF RECORD. The brick or concrete adjustment rings shall be set in mortar or installed as recommended by the manufacturer and as approved by the ENGINEER OF RECORD.

The outside surface of the new brick or block structures shall receive a masonry plaster coat, a minimum of 2 inch thick. The structure shall be properly backfilled with a granular material, compacted in place, and meeting the approval of the ENGINEER OF RECORD. The flow in the entire system shall be maintained, at the CONTRACTOR'S expense, while performing any part of the Work. Also, the structure shall be cleaned and all unsuitable material shall be disposed of at the CONTRACTOR'S expense.

M. Holes

Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, shall be replaced by backfilling to the proposed subgrade with a suitable granular material approved by the ENGINEER OF RECORD. The material shall be placed by the controlled density method or other effective means having the approval of the ENGINEER OF RECORD and shall be compacted to 95% of maximum unit weight.

The furnishing, placing and compacting of the backfill material shall be at the CONTRACTOR'S expense.

N. Restoration

Areas not paved shall be restored in accordance with the type and location specified herein unless indicated otherwise on the Plans. The disturbed areas may be shaped by Machine Grading or another method approved by the ENGINEER OF RECORD to achieve the cross Section, line and grade shown on the Plans. All areas shall be restored with topsoil and sod.

Any excess material from the restoration operation shall be disposed of by the CONTRACTOR at his expense. The disturbed areas shall be graded to receive topsoil and sod. The topsoil and sod shall conform to the requirements specified on the Plans and in Section 329200, Grassing and Mulching.

The CONTRACTOR, at his expense, shall furnish, place, and compact any additional fill, meeting the approval of the ENGINEER OF RECORD, needed to restore the disturbed areas to the cross Sections called for on the Plans or as determined by the ENGINEER OF RECORD.

O. Soil Erosion and Sedimentation Control

If the permit is required, the CONTRACTOR, at his expense, shall prepare all plans, obtain all

approvals, secure all permits and post all bonds and deposits required to comply with Part IV, Chapter 373 Florida Statutes and the Florida Environmental Land and Water Act of 1972 (380.012 F.S. et seq.) and related statutes.

The CONTRACTOR shall provide the OWNER, DESIGN CRITERIA PROFESSIONAL REPRESENTATIVE AND THE ENGINEER OF RECORD with a copy of the soil erosion permit issued by the enforcing agencies for the Project, prior to commencing any type of earthwork on the Project.

P. Excess Excavation

Excess excavation shall be defined as all surplus earth material realized from the construction that is free of brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material.

The CONTRACTOR shall transport all excess excavation to a site(s) approved by the OWNER. The excess excavation shall be graded by the CONTRACTOR to provide positive surface drainage of the site(s). The grading shall be done such that adjacent properties are not damaged or affected. The grading shall include removal of all surface irregularities to provide a smooth surface (+ 0.25 foot). The CONTRACTOR shall be responsible for obtaining and paying for any required permits. Field grading shall be completed based on plan specifications.

Proper disposal of all excess excavation, including transportation, grading, protection of adjacent properties and soil erosion control, shall be considered as a final cleanup item. No additional payment will be made for this item.

Q. Disposal of Unsatisfactory Material

Any brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material from the construction shall become the property of the CONTRACTOR, and shall be disposed of at proper repository. Removal and disposal of this material shall be considered as part of final cleanup. No additional payment will be made for this item.

OWNER and ENGINEER OF RECORD approval of the final site(s) condition in writing will be required prior to final payment authorization.

3.3 MAINTENANCE

Maintain tree protection barriers during the entire course of construction. Any part of a barrier, which has been damaged or destroyed, will be replaced at the start of the next working day.

Do not allow vehicular or pedestrian violation of the tree protection barrier. Do not store materials within tree protection barrier limits.

END OF SECTION

SECTION 31 2200 - SITE GRADING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Scope

This Section includes site grading as indicated on the Plans, complete with removing and salvaging topsoil, rough grading and finish grading.

- B. Related Work Specified Elsewhere

1. Clearing and Grubbing: Section 31 1100
2. General Earthwork: Section 31 2000
3. Erosion Control: Section 31 2500

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PERFORMANCE

- A. Site Grading

Sites shall be graded as specified on the Plans or as directed by the ENGINEER OF RECORD. The CONTRACTOR shall carry out the grading operation to prevent standing water and soil saturation detrimental to structures and improvements. Provisions shall be made to preserve and protect existing trees and other existing vegetation specified on the Plans or directed by the ENGINEER OF RECORD not to be removed. The CONTRACTOR shall submit to the OWNER for approval a staging plan illustrating soil stockpile areas, and how landscaping shall be protected prior to initiating work.

- B. Removing and Salvaging Topsoil

Topsoil shall be salvaged in an amount equivalent to the quantity required by the Plans. Topsoil salvaged in excess of that required by the Plans or as required by the ENGINEER OF RECORD will be disposed of by the CONTRACTOR at his expense.

Before removing topsoil, all vegetation shall be reduced to a height of approximately four (4) inches and all such vegetation and all brush, stones, rocks, and any other objectionable litter or foreign material shall be removed and disposed of before the ground is broken for topsoil removal. Equipment and methods of operations shall be such as to avoid the lifting of the subsoil. If soil or weather conditions are unsuitable, the CONTRACTOR shall cease stripping until directed by the OWNER that stripping can resume.

Topsoil shall be removed within the grading limits for cuts and shall be removed to a width and depth specified on the Plans or as directed by the ENGINEER OF RECORD.

The topsoil shall be stockpiled within the limits of construction in areas designated on the Plans, or used on the slopes as shown on the Plans or as directed by the ENGINEER OF RECORD. Stockpiles shall be located and shaped so as to avoid diversion of storm water runoff, either in or out of the limits of construction, towards buildings, creation of standing water or interference of controlled irrigation. The stockpile shall avoid placing topsoil around trunks and root areas of trees to be preserved.

Topsoil shall be kept separate from other excavated materials which are to be used for embankment and shall be completely removed from any designated area prior to the beginning of regular excavation or embankment in the area.

The topsoil stockpiles shall be located as near the original locations as possible and no payment will be made for overhaul.

C. Rough Grading

The site shall be graded as necessary to comply with the Plans or as directed by the ENGINEER OF RECORD. The rough grade shall be established by cut or fill, approximately parallel to proposed finished grades and to elevations which allow for thickness of topsoil and installation of site or roadway improvements.

In fill areas all debris shall be removed from the area to be filled. All material detrimental to site improvement shall be removed from the site and acceptably disposed of as specified in Section 31 2000, General Earthwork.

Original ground on sloping sites shall be scarified and benched or otherwise treated to provide adequate bond and to prevent slippage of fill.

Fill material shall be free of debris or other detrimental material and shall have reasonable moisture content when placed. All fill shall be compacted to a density not less than 100% of the maximum unit weight and placed in layers no less than nine (9) inches and no greater than 15 inches.

D. Finish Grading

The subgrade shall be smoothed parallel to the proposed finished grades and elevations specified on the Plans. The subgrade shall be scarified to assure bond with the topsoil prior to spreading of the topsoil.

The topsoil shall be spread uniformly to provide a smooth, even surface at a finish grade specified on the Plans or acceptable to the ENGINEER OF RECORD. Topsoil shall be spread only after the OWNER has approved the subgrade. After spreading, the topsoil shall be compacted lightly as necessary to minimize settlement. Final grades shall not vary more than 1/10 of a foot from the elevations indicated on the Plans.

END OF SECTION

SECTION 31 2216 - EARTHWORK FOR PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Scope

This Section includes Earthwork for Paving complete with excavation; subgrade undercut and backfill, embankments; subbase; ditching; restoration; complete with materials, field quality control and appurtenances.

- B. Related Work Specified Elsewhere

1. Clearing and Grubbing: Section 31 1100
2. General Earthwork: Section 31 2000
3. Dewatering: Section 31 2319
4. Base Courses: Section 32 1100

1.3 Quality Assurance

- A. Reference Standards

Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

ASTM - American Society for Testing and Materials

AASHTO - American Association of State Highways and Transportation Officials

FDOT - Florida Department of Transportation

1.4 SUBMITTALS

- A. Test Reports

1. Sieve Analysis

The testing laboratory shall provide the OWNER (2) copies and ENGINEER OF RECORD (1) copy of the test results of the compaction of the backfill. The testing for compaction shall be performed by a testing laboratory approved by the OWNER. The test results shall be signed and sealed by a Professional Engineer.

2. Compaction and Moisture Testing

The testing laboratory shall provide the OWNER (2) copies and ENGINEER OF RECORD (1) copy of the test results of the compaction of the backfill. The testing for compaction shall be performed by a testing laboratory approved by the OWNER. The test results shall be signed and sealed by a Professional Engineer.

3. Bearing Value

The testing laboratory shall provide the OWNER (2) copies and ENGINEER OF RECORD (1) copy of the test results of the compaction of the backfill. The testing for compaction shall be performed by a testing laboratory approved by the OWNER. The test results shall be signed and sealed by a Professional Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Granular Materials

Granular material shall be material passing a 1-inch sieve and at least 12% retained on a No. 200 sieve and meeting the approval of the ENGINEER OF RECORD

PART 3 - EXECUTION

3.1 CONTRACTORS VERIFICATION

A. Existing Improvements

The CONTRACTOR shall expose existing sewers and structures to which the new Work is to be connected and notify the OWNER and ENGINEER OF RECORD so he may verify the vertical and horizontal locations of the existing system and shall inform the CONTRACTOR as to the necessary adjustments required to align the new Work with the existing system.

3.2 PERFORMANCE

A. General

1. CONTRACTOR shall rough grade as close as possible to finished subgrade leaving a minimum to be removed in fine grading.
2. During the excavation operation, including the placing of the subbase, the Work area shall be kept free of water. A dewatering system shall be provided and maintained by the CONTRACTOR at his expense. The dewatering system shall remain in operation as directed by the OWNER and ENGINEER OF RECORD.
3. The finish subgrade surface shall not vary more than 1-inch in ten (10) feet.

B. Pavement Excavation

Pavement excavation shall consist of all Work required to construct the earth grade and its appurtenances true to the lines, grades, and cross sections called for on the Plans and in accordance with these Specifications. Excavation shall consist of the following items, any or all of which may be included or incidental to it; removing trees, stumps, hedges, roots, salvaging and stockpiling topsoil, subgrade or subbase stabilization, excavation for structures, trimming and finishing earth grade, fine grading, right-of-way ditching and restoration, and the disposal of all unsuitable material.

All large stones, trees, stumps, brush, shrubs, logs, matted roots, other vegetation and debris occurring between lines three (3) feet outside the grading limits shall be completely removed and properly disposed of as specified in Section 311100, Clearing and Grubbing.

All earth and other existing materials shall be excavated for the full depth and width of the cross section as shown on the Plans.

Excess excavated material shall be removed from the project by the CONTRACTOR along approved routes to disposal sites approved by the OWNER. Disposal of excess excavation and maintenance of the dump sites shall be considered incidental to the price paid for excavation and shall be as specified in Section 312000, General Earthwork.

C. Salvaging and Stockpiling Topsoil

Topsoil, within the grading limits for cuts, and where the fill is less than five (5) feet in height to the top of road surface, shall be removed to a depth and width specified on the Plans. Topsoil from peat and muck areas shall not be removed. All vegetation shall be cut to a height of approximately six (6) inches and all such vegetation, brush, stones, rocks, and any other objectionable litter or foreign material shall be removed before the ground is broken for removal of topsoil. All vegetation, stones and rocks, and other objectionable litter or foreign material shall be disposed of by the CONTRACTOR. Equipment and methods of operations shall be such as to avoid the lifting of subsoil. Topsoil shall be stockpiled in an approved location within the limits of the project or placed in the slopes as directed by the OWNER and ENGINEER OF RECORD upon completion of the Work; all stockpile areas shall be restored to a neat and satisfactory condition. Topsoil salvaged in excess of that required by the Plans will be disposed of by the CONTRACTOR at his expense.

D. Utility Poles

The CONTRACTOR shall coordinate any removal or relocation required as a result of any conflict of existing utility poles with proposed improvements.

E. Removing Structures

Structures and sewers to be removed shall be called for on the Plans or as directed by the ENGINEER OF RECORD. Any active sewers shall not be removed without written consent of the OWNER and THE ENGINEER OF RECORD.

The structure shall be broken down to at least 12 inches below the subgrade. All pipes connected to the structure shall be plugged with a brick and masonry bulkhead approved by the ENGINEER OF RECORD.

If a structure is to be removed from a system that is to remain in service, the service shall be reconnected. A bypass system, approved by the ENGINEER OF RECORD, AND THE OWNER shall be installed and maintained by the CONTRACTOR, during the rebuilding period.

The broken down structure and void shall be backfilled with a granular material, compacted in place and shall meet with the approval of the ENGINEER OF RECORD

F. Holes

Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, shall be replaced by backfilling to the proposed subgrade with a suitable granular material approved by the ENGINEER OF RECORD. The material shall be compacted to 100% of maximum unit weight.

The furnishing, placing and compacting of the backfill material shall be at the CONTRACTOR'S expense.

G. Preparing Paving Subgrade

All muck, peat and other unsuitable material within the paving area shall be removed, displaced or otherwise treated, as shown on the Plans or as directed by the ENGINEER OF RECORD.

All muck, peat, material and other unsuitable material shall be disposed of outside the site limits or shall be spread uniformly in designated places on the site when so directed and approved by the ENGINEER OF RECORD and approved by the OWNER.

Oil road surfacing or gravel, crushed stone, or other non-rigid type, occurring within the area of the roadbed and underlying proposed embankment less than 1-foot in depth, and which is not to be salvaged and incorporated in the new Work, shall be plowed or scarified full depth, spread and compacted to form a uniform foundation, before any new construction is placed thereon.

Old pavement and other rigid structures, occurring within the area of the building site or new construction less than 1-foot in depth and which are not to be incorporated into the new Work, shall be broken up and removed.

H. Unsuitable Subgrade Excavation

Unsuitable subgrade excavation shall be the operation of removing unsuitable soils below the level of the ground after topsoil has been stripped in fill areas where the embankment is to be five (5) feet or less in height to plan grade, and the removal of unsuitable soils, below the subgrade elevation, as determined by the ENGINEER OF RECORD in cut areas after the subgrade has been established.

In fill areas, after topsoil has been stripped in accordance with paragraph 3.02.C. of this Section, the ENGINEER OF RECORD will inspect the work area to certify the adequacy of the native soils and to determine the extent of any additional excavation of unsuitable soils prior to placing the first lift of any fill material

In cut areas after the subgrade elevation has been established by the mass grading operation, the ENGINEER OF RECORD will inspect the subgrade to determine the extent of any additional excavation of unsuitable soils.

The areas excavated of unsuitable material shall be backfilled with material similar to the adjacent soil, except that when directed by the ENGINEER OF RECORD for areas where free water due to seepage is present, the excavation shall be backfilled with Granular Material approved by the ENGINEER OF RECORD and drainage shall be provided. The backfill shall be compacted to not less than 100% of the maximum unit weight, unless otherwise specified.

I. Embankments

Embankments shall be constructed with sound earth. The materials shall be deposited and compacted as specified in FDOT Section 120.

Where stones are prevalent, the material shall be carefully placed so that all large stones will be well distributed and the crevices completely filled with smaller stones, earth, sand or gravel so as to form a solid embankment. Any rock or fragmental material of such size as would prohibit it from being placed in layers of the specified depth shall not be placed in the embankment. In no case shall stones over three (3) inches in diameter be placed within 12 inches of the surface of the earth grade within the areas between lines two (2) feet outside of the edges of proposed roadbed.

The material for embankments of five (5) feet or less and the bottom four (4) feet of embankments of more than four (4) feet above the surface of the ground upon which the embankment is to be constructed shall have not more than the optimum moisture content at the time of compaction.

The material for that part of the embankment more than five (5) feet above the surface of the ground upon which the embankment is to be constructed shall have a moisture content of not greater than three (3) percent above optimum at the time of compaction, except that the moisture content of the top three (3) feet of the embankment shall not exceed optimum by more than two (2) percent.

If the material contains an excess of moisture, it shall be dried to the required moisture content before being compacted.

Each layer of material containing the required amount of moisture shall be compacted to not less than 100% of the maximum unit weight, unless otherwise specified, before the succeeding layer is started.

When the original ground upon which the embankment is being placed, or any section of compacted embankment, or the soil in cut sections becomes rutted or distorted by the CONTRACTORS equipment, the method of operation shall be changed to eliminate this condition. The CONTRACTOR shall reshape and recompact any areas so rutted or distorted at his own expense. This shall be done before any succeeding layers are placed.

Where the embankment is to be five (5) feet or less in height to the plan grade, the topsoil shall be stripped from the entire fill area. The depth of the topsoil to be removed shall be as shown on the Plans. or as directed by the ENGINEER OF RECORD After the topsoil is removed, the entire area upon which the embankment is to be constructed shall be compacted to not less than 90% of the maximum unit weight, to a depth of nine (9) inches.

Where the embankment is to be more than five (5) feet in height to the plan grade, the original ground over the entire area upon which the embankment is to be constructed shall be compacted to not less

than 90% of the maximum unit weight, to a depth of nine (9) inches.

The maximum unit weight when used as a measure of compaction or density of soils shall be understood to mean the maximum unit weight per cubic foot as determined by the current Method of Test for the Compaction and Density of Soil, AASHTO Designation, T99, Method C, modified to include all the material passing the 1-inch sieve.

J. Borrow Excavation

When provided for in the Proposal, materials that are secured from locations outside of the project limits for the purpose of completing embankments and other items will be considered as borrow excavation. All borrow pits and the materials to be removed there from shall be subject to the inspection of the ENGINEER OF RECORD AND THE OWNER and shall be secured by the CONTRACTOR, unless otherwise provided.

Borrow excavation will be measured by volume in cubic yards compacted in place, based on the neat lines called for on the Plans or as authorized by the ENGINEER OF RECORD. To facilitate the accurate measurement of borrow quantities, the CONTRACTOR shall perform all the regular excavation and grading with existing materials for any designated area and the ENGINEER OF RECORD will cross section these areas prior to the CONTRACTOR furnishing and placing the required borrow material. The ENGINEER OF RECORD will then resection the completed area and compute the volume of borrow material in its compacted-in-place state. Any borrow material placed beyond the neat lines called for on the Plans or which is not authorized by the ENGINEER OF RECORD in writing will not be measured and computed as borrow excavations. Measurement of borrow material by truck count will not be acceptable.

Public and private roads used by the CONTRACTOR between the sources of borrow and the Project shall be maintained by the CONTRACTOR, at his expense, including repairs of any damage caused by his operations, and application of a dust palliative when necessary, as determined by the ENGINEER OF RECORD

K. Subgrade

The area to be paved shall be excavated and graded to the line, grade and cross section as indicated on the Plans.

When called for on the Plans or in the Specifications the designated portions of the roadbed shall be stabilized to provide a firm and unyielding subgrade, having the required bearing value specified on the plans. This work shall be accomplished in accordance with FDOT Section 160.

The subgrade between lines two (2) feet on either side of the proposed edge of pavement or curb shall be compacted to 95% of the maximum unit weight for a depth of seven inches.

The subgrade shall be completed ahead of placing forms a distance equal to the distance of one (1) days average paving operation. Prior to the paving operation, the subgrade shall be shaped and compacted to the Plan cross section by approved mechanical means.

L. Subbase

Subbase material shall be evenly spread and compacted.

The thickness of each layer placed shall be determined by the required density obtained but shall not exceed 15 inches in depth, loose measure.

The subbase shall be constructed to the alignment, grade and cross-section specified. Should the subgrade at any time prior or during the placing of the subbase become soft or unstable so that rutting occurs in the subgrade, or if the subgrade material is forced up into the subbase material, the operation shall immediately cease and the mixed material shall be removed and disposed of. The subgrade shall be corrected and new subbase material placed and compacted, and shall be considered incidental to the construction of the Project.

M. Roadway Ditching

Ditching shall be constructed at the locations called for on the Plans or as directed by the ENGINEER OF RECORD. The ditch may be shaped by Machine Grading or another method approved by the ENGINEER OF RECORD to achieve the cross section, line and grade shown on the Plans.

The excess material from the ditch construction shall be disposed of by the CONTRACTOR at his expense.

The ditch section shall be graded to receive either topsoil and seed or topsoil and sod. The topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified in Section 329200, Grassing and Mulching.

The CONTRACTOR, at his expense, shall furnish, place and compact any additional material needed to construct the ditch at the location and cross sections called for on the Plans.

N. Machine Grading

The Work of machine grading shall consist of light grading of such character that, in general, the excavation from ditches and roadbed will be utilized in shaping shoulders and adjacent shallow fills and the work can be performed by a blade grader or similar equipment. Machine grading shall apply on the Sections shown on Plans or specified in the Proposal.

The Work shall include all necessary scarifying, plowing, disking, moving and shaping the earth to develop the cross section shown on Plans. Ditches shall be in reasonably close conformity with the line and grade as shown on the Plans or as directed and must drain runoff waters to outlets shown on the Plans or designated by the ENGINEER OF RECORD. The roadbed shall be finished to grade with a blade grader or equivalent equipment. All intersections, approaches, entrances, and driveways shall be graded as shown or as directed, except that loading and hauling of earth will not be required as part of this Work.

O. Trimming and Finishing Earth Grade

After the earth grade has been constructed to the required grade, all stones and rocks more than three (3) inches in diameter, appearing on the surface of the subgrade shall be removed.

The earth grade and the subgrade shall be trimmed to the grade called for on the Plans. The subgrade, where a subbase is required, shall be trimmed to the established grade within + 0.1 foot. Where a subbase is not required, the subgrade shall be trimmed to the established grade within + 3/4 inch.

The earth grade outside the subgrade shall be trimmed, all irregularities made smooth and the entire site or roadway completed to the required lines, grades, and cross sections. Backslopes and fill slopes shall be finished as specified or required.

3.3 FIELD QUALITY CONTROL

A. Testing

During the course of the Work, testing will be required for compaction and moisture of the backfill and subgrade materials, sieve analysis of the backfill and subgrade materials, and bearing value of the subgrade. The taking of samples and the testing required shall be performed by the CONTRACTOR'S testing laboratory approved by the OWNER or the ENGINEER OF RECORD.

The ENGINEER OF RECORD shall determine the location and number of samples to be made. The testing laboratory shall furnish the OWNER with (2) copies and the ENGINEER OF RECORD with (1) copy of the results of all tests. Testing procedures shall conform to current FDOT Standards for Construction. The cost for testing and sampling shall be at the expense of the OWNER.

B. Defective Work

Any portion of the backfill or subgrade, which is deficient in the specified density or bearing value, shall be corrected by methods meeting the approval of the ENGINEER OF RECORD.

Any extra testing or sampling required by the OWNER or ENGINEER OF RECORD because of deficiencies shall be at the CONTRACTORS expense.

END OF SECTION

SECTION 31 2300 - STRUCTURE EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. Scope

This Section includes excavation for structures, removal and disposal of excavated materials, backfilling, backfill materials and compaction.

B. Related Work Specified Elsewhere

- 1. Clearing and Grubbing: Section 31 1100
- 2. General Earthwork: Section 31 2000
- 3. Site Grading: Section 31 2200
- 4. Dewatering: Section 31 2319

1.3 QUALITY ASSURANCE

A. Reference Standards

Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

ASTM - American Society of Testing and Materials

AASHTO - American Association of State Highway Transportation Officials

FDOT- Florida Department of Transportation

Hillsborough County Technical Specifications

1.4 SUBMITTALS

A. Test Reports

1. Compaction

The testing laboratory shall provide the OWNER (2) copies and ENGINEER OF RECORD (1) copy of the test results of the compaction of the backfill. The testing for compaction shall be performed by a testing laboratory approved by the OWNER. The test results shall be signed and sealed by a Professional Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bedding Material

Bedding material for use below the water table or in wet trenches shall be pea rock, drainfield limerock or similar material as approved by the Owner's Engineer. Pipe bedding material for use in dry trenches

shall be limerock screenings, sand or other fine inorganic material as approved by the Owner's Engineer.

B. Additional Backfill Material

Additional backfill material shall be classified as A-1, A-3 or A-2-4 in accordance with AASHTO Designation M 145 and shall be free from vegetation and organic material. No stones or rocks shall be larger than 6-inches in diameter, and when placed within 1-foot of piping and appurtenances stones or rocks shall be no larger than 2-inches in diameter (1-inch for PVC).

C. Portland Cement Concrete Mixture

Provide Portland Cement Concrete having a 28-day compressive strength of 3000 psi and conforming to FDOT Standard Specifications for concrete work.

PART 3 - EXECUTION

3.1 PREPARATION

A. Dewatering

The area within the vicinity of the new Work shall be dewatered in accordance with Section 312319 prior to the excavation operation. The depth of the dewatering shall be sufficient to allow the excavation to remain in a dry condition during the construction of the structure, including the excavating, backfilling and compacting operations.

3.2 PERFORMANCE

A. Excavation

All excavation shall be backfilled in accordance with the Hillsborough County Technical Specifications unless noted otherwise.

Excavation shall include the site clearing and grubbing, the excavating and disposing of all materials encountered, the supporting and protecting of all structures and/or utilities encountered above and below the ground surface, and the removal of water from the construction site. Excavation shall also include the removal of existing structures, as shown on the Plans or as directed by the ENGINEER OF RECORD. Rock excavation, if applicable, shall be performed as a part of the excavation in accordance with specifications contained elsewhere.

The CONTRACTOR shall keep the limits of his excavation operations within a reasonable close conformity with the location and grade, of each structure.

The excavated materials shall be temporarily stored in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property or traffic. The excavated materials shall not be placed at such locations that will endanger the banks of the excavation by imposing loads thereon.

The excavation shall be of sufficient size to allow for the construction of the new work, the placing and compacting of the backfill and for the dewatering operation.

When concrete is to bear on or against an excavated surface other than rock, special care shall be taken not to disturb the surface. The final removal of the foundation material to grade shall not be made until just prior to the placing of the concrete.

Concrete shall not be placed until the depth of the excavation has been checked and the suitability of foundation material has been reviewed by the ENGINEER OF RECORD.

The elevations for the bottom of footings shall be subject to such changes as are necessary to insure a satisfactory foundation. Any changes required shall be reviewed by the ENGINEER OF RECORD prior to making the change.

The surface of all rock or other hard material upon which concrete is to be placed shall be freed from all

loose fragments, cleaned and cut to a firm surface. The surface shall be level, stepped or serrated, as shown on the Plans.

All unsound material underlying proposed structures shall be removed and replaced with suitable material approved by the ENGINEER OF RECORD, in layers not exceeding six (6) inches in depth. Each layer shall be compacted to 100% of maximum unit weight unless indicated otherwise on the Plans, or within these specifications.

B. Sheeting, Shoring, and Bracing

The CONTRACTOR shall furnish, place and maintain at all times such sheeting, shoring, and bracing of the excavated area as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipelines and conduits next to, or crossing the excavated area, and for the protection and safety of pedestrian and vehicular traffic.

The CONTRACTOR shall be responsible for the complete design of all the sheeting, shoring, and bracing Work. Prior to installing the sheeting, shoring or bracing, the CONTRACTOR shall submit Plans for this Work to the ENGINEER OF RECORD for his information.

Sheeting, shoring and bracing shall conform to current federal or state regulations for safety.

Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring and bracing in place. No extra compensation shall be paid to the CONTRACTOR for sheeting, shoring or bracing left in place.

Supports for pipes, conduits, etc., crossing the excavated area shall conform to the requirements of the owners of such facilities and if necessary, shall be left in place.

The furnishing, placing, maintaining and removing of sheeting, shoring and bracing materials shall be at the CONTRACTOR'S expense.

The CONTRACTOR shall not remove the sheeting, shoring or bracing until the structure has obtained sufficient strength to support the external loads. The sheeting, shoring and bracing material shall not come in contact with the structure, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the structure.

C. Cofferdams

A cofferdam shall consist of the maintenance, installation and removal of a substantially watertight enclosure or a well-point system or similar system, which will permit construction of the substructure, above seal or subfooting, in the dry and without damage to the Work. Alternate methods, where used in lieu of cofferdams, will be permitted by Authorization only. Such Authorization will be considered only after receipt of applicable permits for the alternate method.

Stream diversion and earth dikes, where used in lieu of cofferdams or a well-point system will be permitted by authorization only. Such authorization will be considered only after receipt of the appropriate permits for such construction.

The interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit dewatering outside of the forms.

Cofferdams or cribs, which are tilted or moved laterally during the process of sinking, shall be righted or enlarged so as to provide the necessary clearance.

Cofferdams shall not be braced to substructure forms. They shall be constructed so as to protect the Work in place against damage from high water and to prevent injury to the foundation by erosion. No timber bracing shall extend into or remain in the finished concrete.

Cofferdams shall be removed in such a manner as not to disturb or mar the finished concrete. When called for on the Plans or where necessary in the Work, cofferdam sheeting shall be left in place.

The furnishing, construction, maintenance and removal of the cofferdams including pumping shall be at

the CONTRACTOR'S expense.

If the CONTRACTOR elects to use a well-point system or similar system, he shall be responsible for any claims for damages resulting there from.

D. Backfill

Backfill material shall be placed only after the new Work and backfill material have been inspected by the ENGINEER OF RECORD. Excavated material, determined by the ENGINEER OF RECORD as suitable for backfill may be used.

Backfill shall not be placed against any portion of the new Work until the required curing; surface finishing and waterproofing of such portions have been completed. Backfill, which will place an unequalized horizontal loading on the new Work, shall not be placed until the concrete has attained at least 70% of its design strength. To equalize horizontal loadings, the required backfill around the new Work shall be placed on opposite sides at the same time.

Granular material acceptable to the testing and inspection agency ENGINEER OF RECORD shall be used for backfilling the new Work unless otherwise indicated on the Plans or within these specifications.

All spaces excavated and not occupied by the new Work or by the specified backfill material, shall be backfilled with suitable material from the excavation.

After the backfill has been placed and compacted to the flow line elevation of any weepholes indicated on the Plans, the back end of each weephole shall be covered with not less than two (2) cubic feet of No. 6 or 7 coarse aggregate.

Large stones, boulders, broken rocks, concrete, and masonry shall not be used in the backfill.

The backfill shall be carried up to the surface of the adjacent ground or to the elevation of the proposed finished grade, and its top surface shall be neatly graded. Fills around all new Work shall be trimmed to the lines shown on the Plans or as directed by the ENGINEER OF RECORD

E. Compacting Backfill

Backfill material shall be placed in accordance with the methods specified in the Hillsborough County Technical Specifications or the agency having jurisdiction.

The backfill material shall be compacted to 98% of its maximum unit weight.

The maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot as determined by AASHTO T180.

Compaction of the backfill will not be paid for separately, but shall be considered incidental to the Work of backfilling and shall include all the Work of manipulating the soil to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

F. Cleanup

Immediately following the placing and compacting of the backfill, the excess material shall be removed and disposed of by the CONTRACTOR, at his expense, as specified in 312000, General Earthwork.

The construction area shall be graded and left in a neat, workmanlike condition.

3.3 FIELD QUALITY CONTROL

A. Testing

During the course of the Work, testing will be required for compaction or density of the backfill. The taking of samples and the testing required shall be performed by an independent testing laboratory

approved by the OWNER, AND THE ENGINEER OF RECORD. The cost for testing and sampling shall be at the expense of the CONTRACTOR.

The testing laboratory shall furnish the OWNER (2) copies and ENGINEER OF RECORD (1) COPY of the results of all tests. Test results shall be signed and sealed by a Professional Engineer. Testing procedures shall conform to current Hillsborough County Technical Specifications.

B. Defective Work

Any portion of the backfill which is deficient in the specified density shall be corrected by the methods meeting the approval of the ENGINEER OF RECORD. Any extra testing or sampling required because of apparent deficiencies shall be at the CONTRACTOR'S expense. Material damaged by backfill compaction or other work is subject to rejection by the OWNER, AND/OR THE ENGINEER OF RECORD.

END OF SECTION

SECTION 31 2319 - DEWATERING

PART I - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Scope

This Section includes all dewatering work complete with design of dewatering systems, constructing and operation of dewatering systems, abandonment of dewatering systems, protection of personnel and structures, environmental protection and restoration.

- B. Related Work Specified Elsewhere

- 1. General Earthwork: Section 31 2000
- 2. Structure Excavation and Backfill: Section 31 2300

1.3 QUALITY ASSURANCE

- A. Design of Dewatering Construction

The CONTRACTOR shall be responsible for the complete design of all structures and methods proposed for dewatering the project site, including the implementation of all materials, tools and equipment proposed for use in the Work. Temporary wiring associated with the dewatering shall comply with applicable portions of the National Electrical Code.

- B. Requirements of Regulatory Agencies

- 1. Soil Erosion and Sedimentation Control

All dewatering systems design and construction shall conform to the provisions of Part IV, Chapter 373 Florida Statutes (F.S.) and the Florida Environmental Land and Water Management Act of 1972 (380.012 F.S. et seq.) and related statutes. Where applicable, the CONTRACTOR shall obtain and pay for all permits and inspections for dewatering construction in accordance with the provisions of Part IV, Chapter 373 Florida Statutes (F.S.), the Florida Environmental Land and Water Management Act of 1972 (380.012 F.S. et seq.), related statutes, and all local government agencies having jurisdiction. No additional claim for compensation shall be allowed because of the CONTRACTOR'S failure to obtain or pay for such permits and inspections.

- 2. Federal, State, and Local Regulations

Dewatering operations shall conform to the requirements of all federal, state, and local agencies having jurisdiction.

1.4 JOB CONDITIONS

- A. Protection

Take all steps necessary, during the Work of this Section, to protect surrounding property and adjacent buildings, private water supplies, roads, drains, sewers, structures and appurtenances. Adequate measures shall be taken to protect such property and construction from the effects of the dewatering operations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTRACTOR'S VERIFICATION

A. Existing Drainage Conditions

Prior to beginning any work, verify in the field the location, type and capacity of all existing drainage facilities and conditions, which will affect the Work of this Section. No allowances shall be made for conditions found during the progress of the dewatering operations because of the CONTRACTOR'S failure to verify such conditions.

The CONTRACTOR shall submit a staging plan and schedule prior to commencement of the work for OWNER and ENGINEER OF RECORD'S approval. The plan shall indicate areas to be dewatered and discharge areas. The CONTRACTOR shall promptly correct or modify, at no additional cost to the OWNER, operations that impact or affect facility events or operations.

B. Existing Structure and Utilities

The CONTRACTOR shall make field verification of all existing structures and utilities at the site of the Work, which are scheduled to remain, and which may be affected by the Work of this Section. The CONTRACTOR shall be responsible for any damage to existing structures and/or utilities caused because of his Work and shall repair such damage at his expense to the satisfaction of the OWNER and ENGINEER OF RECORD.

3.2 PERFORMANCE

A. Drainage of Excavations

The CONTRACTOR shall maintain all finished excavation Work free of water during the preparation of the subgrade and until the completion of the Work. No ground or surface water shall be discharged into any existing sanitary sewer. No unit of Work shall be constructed under water except as otherwise directed by the ENGINEER OF RECORD. Provide and maintain adequate dewatering equipment to remove and dispose of all surface or groundwater entering excavations, trenches or other parts of the Work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the construction is complete. All excavations which extend down to or below the static groundwater elevation shall be dewatered by lowering and maintaining the groundwater level beneath such excavations at a distance of not less than 12 inches below the bottom of the excavation or as directed by the ENGINEER OF RECORD. Drainage system methods shall not cause any damage to wells, adjacent property, or facility events or operations. All outlet drainage piping and conduit shall be kept clean and free from sediment. The CONTRACTOR shall be held responsible for the condition of all pipes, conduits and structures, which he may use for drainage.

B. Dewatering Sumps and Pump Wells

Sumps and pump wells used as a part of the dewatering system shall be strongly sheathed and braced to protect the construction while in use. Tops of well casings must be covered to prevent people, animals, and debris from entering and shall be two to three feet above ground. Sumps and wells, when abandoned shall be backfilled and compacted to the satisfaction of the OWNER and ENGINEER OF RECORD.

C. Drilling

Methods used in drilling wells associated with dewatering systems shall be the responsibility of the CONTRACTOR and shall be acceptable to the ENGINEER OF RECORD. Drilling methods shall insure proper placement of well materials and shall not involve displacement of earth formations. Drilling shall be done with first class equipment of proper type and in good condition, acceptable to the ENGINEER OF RECORD.

D. Pumping

Equipment for pumping and pumping methods associated with dewatering systems shall be the responsibility of the CONTRACTOR and shall be acceptable to the ENGINEER OF RECORD. The CONTRACTOR shall construct or furnish adequate discharge piping to conduct and dispose of the water so as to prevent damage to existing structures or property. Pumping equipment shall be first class, acceptable to the ENGINEER OF RECORD, of proper type and size for the Work and in good condition. Provide all anchors and supports for pumping equipment.

E. Filling and Grading

Upon completion of dewatering Work for the Project, abandon and/or fill all holes, trenches, ditches and other earth excavations created by the Work of this Section not scheduled to remain. Do all filling, backfilling and grading to restore excavations and earth banks to the lines and levels indicated on the Plans and as directed by the ENGINEER OF RECORD. All earth fills shall be compacted to a density equal to that of the surrounding undisturbed earth.

END OF SECTION

SECTION 31 2333 - TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Scope

This Section includes open trench construction, complete with trenching, sheeting, shoring, bracing, backfilling, backfill materials and compaction.

- B. Related Work Specified Elsewhere

- 1. Clearing and Grubbing: Section 31 1100
- 2. Dewatering: Section 31 2319
- 3. General Earthwork: Section 31 2000

1.3 QUALITY ASSURANCE

- A. Reference Standards

Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

ASTM - American Society of Testing and Materials

AASHTO - American Association of State Highway Transportation Officials

FDOT - Florida Department of Transportation

OSHA - Occupational Safety and Hazard Administration

Hillsborough County Technical Specifications

1.4 SUBMITTALS

- A. Test Reports

- 1. Compaction

The testing laboratory shall provide the OWNER (2) copies and ENGINEER OF RECORD (1) copy of the test results of the compaction of the backfill. The testing for compaction shall be performed by a testing laboratory approved by the OWNER. The test results shall be signed and sealed by a Professional Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Bedding Material

Bedding material for use below the water table or in wet trenches shall be pea rock, drainfield limerock or similar material as approved by the Owner's Engineer. Pipe bedding material for use in dry trenches

shall be limerock screenings, sand or other fine inorganic material as approved by the Owner's Engineer.

B. Additional Backfill Material

Additional backfill material shall be classified as A-1, A-3 or A-2-4 in accordance with AASHTO Designation M 145 and shall be free from vegetation and organic material. No stones or rocks shall be larger than 6-inches in diameter, and when placed within 1-foot of piping and appurtenances stones or rocks shall be no larger than 2-inches in diameter (1-inch for PVC).

C. Portland Cement Concrete Mixture

Provide Portland Cement Concrete having a 28-day compressive strength of 3000 psi and conforming to FDOT Standard Specifications for concrete work.

PART 3 - EXECUTIONS

3.1 PREPARATION

A. Dewatering

The area within the vicinity of the trenching operation shall be dewatered in accordance with Section 312319 prior to the trenching operation. The depth of the dewatering shall be sufficient to allow the trench excavation operation including backfilling and compacting to proceed in a dry condition.

3.2 PERFORMANCE

A. Trench Excavation

Open cut trench excavation shall include the site clearing and grubbing, the excavating and disposing of materials encountered, the supporting and protecting of all structures and/or utilities encountered above and below the ground surface, and the removal of water from the construction site.

The trench shall be excavated in reasonable close conformity with the lines and grades on the Plans or as established by the ENGINEER OF RECORD

The excavated materials shall be temporarily stored along the trench in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property or traffic. The excavated materials shall not be placed at such locations that will endanger the trench banks by imposing loads thereon.

The trench shall be of sufficient width to provide adequate working space to permit the installation of the pipe and the compaction of the bedding material under and around the pipe. However, the width of the trench from below the pipe bedding to 12 inches above the top of the pipe shall not exceed the dimensions shown on the plans.

To support the additional load of the backfill when the maximum trench width as specified for rigid pipe is exceeded, the CONTRACTOR shall install, at his expense, concrete encasement which shall completely surround the pipe and shall have a minimum thickness at any point of 1/4 of the outside diameter of the pipe or four (4) inches, whichever is greater, or at his expense, install another type bedding, approved by the ENGINEER OF RECORD. The concrete encasement shall consist of 3,000-psi strength concrete.

To support the additional load of the backfill when the maximum trench width as specified for flexible or semi-rigid pipe is exceeded, the CONTRACTOR shall install, at his expense, standard pipe bedding to the full width between undisturbed trench walls or at least 2.5 pipe diameters on each side of the pipe.

When, through the CONTRACTOR'S construction procedure or because of unsuitable existing ground conditions, it becomes impossible to maintain alignment and grade properly, the CONTRACTOR, at his expense, shall excavate below the normal trench bottom grade and shall fill the void with a large size aggregate or 2,500 psi concrete as approved by the ENGINEER OF RECORD to insure that the pipe

when laid in the proper bedding will maintain correct alignment and proper grade.

All trench excavations, including those for shafts and structures, shall be adequately braced and/or sheeted where necessary to prevent caving or squeezing of the soil.

B. Sheeting, Shoring, and Bracing

The CONTRACTOR shall furnish, place and maintain at all times such sheeting, shoring, and bracing of the trench and/or shaft as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipelines and conduits next to, or crossing the trench area, and for the protection and safety of pedestrian and vehicular traffic.

The CONTRACTOR shall be responsible for the complete design of all the sheeting, shoring, and bracing Work. Prior to installing the sheeting, shoring or bracing, the CONTRACTOR shall submit Plans for this Work to the ENGINEER OF RECORD for review and the OWNER for their information.

Sheeting, shoring and bracing shall conform to current federal or state regulations for safety.

Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring and bracing in place. No extra compensation shall be paid to the CONTRACTOR for sheeting, shoring or bracing left in place.

Supports for pipes, conduits, etc., crossing the trench shall conform to the requirements of the owners of such facilities and if necessary, shall be left in place.

The furnishing, placing, maintaining and removing of sheeting, shoring and bracing materials shall be at the CONTRACTORS expense.

The CONTRACTOR shall not remove the trench sheeting, shoring or bracing unless the pipe has been properly bedded and the trench backfilled to sufficiently support the external loads. The sheeting, shoring and bracing material shall not come in contact with the pipe, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the pipe.

C. Backfilling Trenches

All excavations shall be backfilled in accordance with the Hillsborough County Technical Specifications unless noted otherwise.

Backfill material shall be placed on Sections of bedded pipes only after such pipe bedding and backfill materials have been approved by the ENGINEER OF RECORD

The backfill shall be carried up to the surface of the adjacent ground or to the elevation of the proposed finished grade, and its top surface shall be neatly graded.

The trench backfilling shall follow the pipe laying as closely as possible. However, at no time shall the pipe laying in any trench precede backfilling of that trench by more than 100 feet, unless otherwise directed by the ENGINEER OF RECORD

The backfill material shall be compacted to 98% of its maximum unit weight unless otherwise shown on the plans and shall be placed in accordance with the Hillsborough County Technical Specifications.

The maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot as determined by AASHTO T-180.

Compaction of the backfill will not be paid for separately, but shall be considered incidental to the Work of backfilling and shall include all the Work of manipulating the soil, to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

D. Cleanup

Immediately following the placing and compacting of the backfill, the excess material shall be removed

and disposed of by the CONTRACTOR, at his expense, as specified in Section 312000, General Earthwork.

The construction area shall be graded and left in a neat, workmanlike condition.

3.3 FIELD QUALITY CONTROL

A. Testing

During the course of the Work, testing for compaction or density of the backfill will be required. The taking of samples and the testing required shall be performed by the CONTRACTOR'S testing laboratory approved by the OWNER'S REPRESENTATIVE. The cost for testing and sampling shall be at the expense of the CONTRACTOR

The testing laboratory shall furnish the OWNER (2) copies of the results of all tests. Test results shall be signed and sealed by a Professional Engineer. Testing procedures shall conform to AASHTO T180 and to current Hillsborough County Technical Specifications.

B. Defective Work

Any portion of the backfill, which is deficient in the specified density, shall be corrected by the methods meeting the approval of the ENGINEER OF RECORD. Any extra testing or sampling required because of apparent deficiencies shall be at the CONTRACTOR'S expense. Materials damaged by backfill compaction or other work are subject to rejection by the OWNER and ENGINEER OF RECORD.

END OF SECTION

SECTION 31 2500 - EROSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. The work of this section consists of furnishing all necessary labor, equipment, material and transportation necessary to provide temporary and permanent erosion and sediment control as required by appropriate government agency permits, the plans and as noted in this specification.

PART 2 - EXECUTION

2.1 INSTALLATION

- A. Install temporary erosion and sediment control items prior to clearing and commencing earthwork or as soon as practical as sitework progresses.

2.2 PROTECTION

- A. **Stabilization of Denuded Areas:** No disturbed area may be denuded for more than thirty (30) calendar days, (excluding rights-of-way) unless otherwise authorized by the Owner's Engineer. During construction, denuded areas shall be covered by mulches such as straw, hay, filter, seed and mulch, sod or some other permanent vegetation. Within sixty (60) calendar days after final grade is established on any portion of a project site, that portion of the site shall be provided with established permanent soil stabilization measures per the original site plan, whether by impervious surface or landscaping.
- B. **Protection and Stabilization of Stockpiles:** Fill material stockpiles shall be protected at all times by on-site drainage controls which prevent erosion of the stockpiled material. Control of dust from such stockpiles may be required, depending upon their location and the expected length of time the stockpiles will be present. In no case shall an unstabilized stockpile remain after thirty (30) calendar days.
- C. **Protection of Existing Storm Sewer Systems:** During construction, all storm sewer inlets shall be protected by approved sediment traps such as secured hay bales, sod, stone, etc., which shall be maintained and modified as required by construction progress, and which must be approved by the Owner's Engineer.
- D. **Sediment Trapping Measures:** Sediment basins and traps, perimeter berms, filter fences, berms, sediment barriers (hay bales), vegetative buffers and other measures intended to trap sediment and/or prevent the transportation of sediment onto adjacent properties, or into existing water bodies, must be installed, constructed or, in case of vegetative buffers, protected from disturbance, as a first step in the land alteration process.
- E. **Working in or Crossing Waterways or Waterbodies:** Land alteration and construction shall be minimized in both permanent and intermittent waterways and the immediately adjacent buffer of 25 feet from top of bank of the waterways and the buffer area whenever possible, and barriers shall be used to prevent access. Where channel work cannot be avoided, precautions must be taken to stabilize the work area during land alteration, development and/or construction to minimize erosion. If the channel and buffer area are disturbed during land alteration, they must be stabilized within three (3) calendar days after the in channel work is completed.

Silt curtains or other filter/siltation reduction devices must be installed on the downstream side of the in channel alteration activity to eliminate impacts due to increased turbidity. Whenever stream crossings are required, properly sized temporary culverts shall be provided by the Contractor and removed when

construction completed. The area of the crossing shall be restored to a condition as nearly as possible equal to that which existed prior to any construction activity.

- F. Swales, Ditches and Channels: All swales, ditches and channel leading from the site shall be sodded within three (3) days of excavation. All other interior swales, etc., including detention areas will be sodded prior to issuance of as Certificate of Occupancy.
- G. Underground Utility Construction: The construction of underground utility lines and other structures shall be done in accordance with the following standards:
 - 1. No more than 500 lineal feet of trench shall be open at any time;
 - 2. Wherever consistent with safety and space consideration, excavated material shall be cast to the uphill side of trenches. Trench material shall not be cast into or onto the slope of any stream, channel, road ditch or waterway.

2.3 PERFORMANCE

- A. Maintenance: All erosion and siltation control devices shall be checked regularly, especially after each rainfall and will be cleaned out and/or repaired as required.
- B. Compliance: Failure to comply with the aforementioned requirements may result in a fine and/or more stringent enforcement procedures such as, but not limited to, issuance of a "Stop Work Order".

END OF SECTION

SECTION 31 3116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following for termite control:
 - 1. Soil treatment.

1.3 DEFINITIONS

- A. EPA: Environmental Protection Agency.
- B. PCO: Pest control operator.

1.4 SUBMITTALS

- A. Product Data: Treatments and application instructions, including EPA-Registered Label.
- B. Product Certificates: Signed by manufacturers of termite control products certifying that treatments furnished comply with requirements.
- C. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.
- B. Applicator of termite treatment shall contract directly with the GC or CM, not with a subcontractor.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with EPA-Registered Label requirements and requirements of authorities having jurisdiction.
- B. Prior to each application, applicators must notify the construction superintendent of similar responsible party of the intended termiticide application and sites of application and instruct the responsible person to notify workers and other individuals on site to leave the area to be treated during application until the termiticide is absorbed into the soil

1.7 COORDINATION

- A. Coordinate soil treatment application with excavating, filling, and grading and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs, before construction.

1.8 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
- C. Identification: the Warranty shall identify the chemical used and the building number(s) to which it was applied.
- D. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

- A. Termiticide: Provide one of the following non-repellant chemicals:
 - 1. Imidacloprid (such as Premise 75), diluted to the strongest allowable concentration according to the manufacturer's written instructions.
 - 2. Fipronil (such as Termidor 80 WG), diluted to the strongest allowable concentration according to the manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of the soil, interfaces with earthwork, slab and foundation work, landscaping, and other

conditions affecting performance of termite control. Proceed with application only after unsatisfactory conditions have been corrected.

1. Do not treat soil that is too moist or if there is standing water.
- B. Product is to be delivered to the site in its original labeled containers.

3.2 PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.
- C. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.
- D. Prior to each application, applicator shall notify the Contractor of the intended termiticide application and intended sites of application and instruct the Contractor to notify workers and other individuals on site to leave the area to be treated during application and until the termiticide is absorbed into the soil.
- E. Subcontractor shall mix the chemical on site from original, unopened, labeled containers. Construction Manager is responsible for enforcing this requirement and verifying dilution rates.
- F. Notify the School Board Inspections Department 48 hours prior to applying the chemical. Owner will observe application.

3.3 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.
- B. Scope: Protect against subterranean termites for all new construction and whenever the soil under existing construction is disturbed.

3.4 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute the treatment evenly.
 1. Slabs-on-Grade: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 2. Foundations: Adjacent soil including soil along entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footers, piers, and chimney bases; and along entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 - a. When treating foundations deeper than 4 feet, apply the termiticide as the backfill is being replaced, or failing this, treat the foundation to a minimum depth of 4 feet after the backfill has been installed by trenching and rodding into the trench or trench along the foundation walls and around pillars and other foundation elements at the rate prescribed from grade to a minimum depth of 4 feet.
 - b. When the top of the footing is exposed, treat the soil adjacent to the footing to the bottom of the footing. Do not treat below the footings.
 3. Masonry: Treat CMU cells in stem walls to the top of the footing. Apply at the strongest allowable concentration and rate according to manufacturer's instructions. Apply so that the emulsion will reach the top of the footing.
 4. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Horizontal Barriers: Create a horizontal barrier whenever treated soil will be covered, such as footing trenches, slabs, and the soil beneath stairs, crawlspaces and sidewalks adjacent to the building.
 1. Apply at the strongest allowable concentration and rate according to manufacturer's instructions. If the fill is washed gravel or other coarse material, apply a sufficient amount of dilution to reach the soil substrate beneath the coarse fill.
 2. Applications shall be made per manufacturer's instructions. If slab will not be placed the same day as treatment, cover treated soil with a waterproof barrier such as polyethylene sheeting. If the slab is not placed within 24 hours of treatment, re-treat the area.
- C. Vertical Barriers: Create vertical barriers around the base of foundations, plumbing, utility entrances, back-filled soil against foundation walls and other critical areas.
 1. Apply 4 gallons of dilution per 10 linear feet per foot of depth to ensure complete coverage.

2. When trenching and rodding into the trench, or trenching, ensure that the emulsion reaches the top of the footing. Space rod holes to achieve a continuous termiticidal barrier, but in no case more than 12 inches apart.
3. Avoid soil washouts around the footings.
4. Trenches need not be wider than 6 inches. Emulsion shall be mixed with the soil as it is being replaced in the trench.
5. For a monolithic slab, an inside vertical barrier may not be required.
- D. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- E. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- F. Post warning signs in areas of application.
- G. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application or if not covered within 24 hours.
- H. Do not apply soil treatment if the ground conditions in the area to be treated are too moist or if standing water is present.

END OF SECTION

SECTION 32 1100 - BASE COURSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Scope

This Section includes base courses constructed by one (1) of the following methods:

- 1. Limerock Base

The work specified in this Section consists of the construction of a base course composed of limerock or asphalt base course(s). It shall be constructed on the prepared subgrade, in accordance with these specifications and in conformity with the lines, grades, notes and typical cross section shown in the plans.

- 2. Limerock Stabilized Base

The work specified in this Section consists of the construction of a base course composed of roadbed soil stabilized with limerock, in accordance with these specifications and in conformity with the lines, grades, notes and typical cross section shown in the plans.

- 3. Crushed Concrete Base

The work specified in this Section consists of the construction of a base course composed of crushed concrete, on the prepared subgrade, in accordance with these specifications and in conformity with the lines, grades, notes, and typical cross sections shown in the plans.

When the specified compacted thickness of the base is greater than six (6) inches the base shall be constructed in two (2) or more courses. The thickness of the first course shall be approximately one-half the total thickness of the finished base, or enough additional to bear the weight of the construction equipment without disturbing the subgrade.

- 4. Shell Base

The work specified in this Section consists of the construction of a base course composed of shell. It shall be constructed on the prepared subgrade, in accordance with these specifications and in conformity with the lines, grades, notes, and typical cross sections shown in the plans. When the base is to be constructed to a compacted thickness greater than 6-1/2 inches it shall be constructed in two (2) courses.

- 5. Shell Stabilized Base

The work specified in this Section consists of the construction of a base course by stabilizing the soil material with shell, in accordance with these specifications and in conformity with the lines, grades, notes, and typical cross sections shown in the plans.

- 6. Soil-Cement Base

The work specified in this Section consists of the construction of a base course composed of a combination of soil and Portland cement, uniformly mixed, moistened, compacted, finished, and cured, in accordance with these specifications, and shaped to reasonably close conformance with the lines, grades, thicknesses, and typical cross sections shown in the plans or established by the OWNER.

B. Related Work Specified Elsewhere

1. GENERAL EARTHWORK: Section 31 2000
2. EARTHWORK FOR PAVING: Section 31 2216
3. BITUMINOUS PAVING: Section 32 1113
4. PORTLAND CEMENT CONCRETE PAVING: Section 32 1133

1.3 QUALITY ASSURANCE

A. Reference Standards

Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

ASTM - American Society of Testing and Materials

AASHTO - American Association of State Highways and Transportation Officials

FDOT - Florida Department of Transportation

B. Allowable Tolerances

1. Base Courses

The finished surface shall be shaped to conform to within a tolerance of 3/4 inch in ten (10) feet to the cross section and grades called for on the Plans.

1.4 SUBMITTALS

A. Test Reports

1. Thickness

The testing lab shall provide the OWNER with (2) copies and ENGINEER OF RECORD (1) copy of the test results of the thickness of the compacted base. The core drilling and testing for thickness shall be performed by the CONTRACTOR'S testing laboratory approved by the OWNER. Test results shall be signed and sealed by a Professional Engineer.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The base course material shall be transported to the point where it is to be used, over material previously placed if practicable, and dumped on the end of the preceding spread. Hauling over the subgrade and dumping on the subgrade will be permitted when, in the ENGINEER OF RECORD'S opinion, these operations will not be detrimental to the base.

1.6 JOB CONDITIONS

A. Environmental Requirements

1. Temperature

Comply with the requirements for aggregate base course installations due to outside ambient air temperatures specified under Article 3.03 of this Section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Limerock Base

The limerock material shall meet the requirements of FDOT Section 911. At the CONTRACTORS option limerock of either Miami or Ocala formation may be used, but limerock of only one (1) formation may be used on any contract. (Limerock may be referred to hereinafter as rock.)

B. Limerock Stabilized Base

The stabilizing material used for this construction shall consist of limerock meeting the requirements of FDOT Section 911, as specified for the material to be used in this work.

C. Crushed Concrete Base

The materials used shall conform with the requirements specified in FDOT Section 204 and FDOT Section 901-5. Before any base course material is used it shall first have been tested by the CONTRACTOR'S laboratory and approved by the OWNER AND/OR ENGINEER OF RECORD.

D. Shell Base

The shell material shall meet the requirements of FDOT Section 913. Where specifically called for in the plans, coquina shell (meeting the requirements of FDOT Section 915) shall be used; otherwise, coquina shell may be permitted at the CONTRACTORS request, if so approved by the ENGINEER OF RECORD.

E. Shell Stabilized Base

The shell material used shall conform with the requirements of FDOT Section 913. All roadbed material to be incorporated with the shell shall have at least the bearing value required by the plans for the subgrade.

F. Soil-Cement Base

The materials used shall conform with the following requirements:

1. Portland cement, Type I or Type I-P FDOT Section 921.
2. Water shall be free from substances deleterious to hardening of the soil-cement mixture.
3. Emulsified Asphalt Grade SS-1* or SS-1H* FDOT 916-4. *Diluted in equal proportion with water.
4. Soil: the soil used for base course construction shall be either the material existing in the location to be occupied by the base, a suitably friable material obtained from pits furnished by the CONTRACTOR or a combination of these. If the material existing in the location to be occupied by the base does not meet the requirements set out below, it shall be removed and replaced with suitable soil.

Material pits furnished by the CONTRACTOR shall be approved prior to use. Material pits shall be excavated in a manner so as to achieve a uniformly mixed material with reasonably consistent characteristics. Any blending of strata shall be done in accordance with a procedure approved by the ENGINEER OF RECORD.

Specific Requirements for Soil:

Organic Material: Maximum 3%

Gradation:

Passing 2-inch sieve	100% (minimum)
Passing No. 4 sieve	55% (minimum)
Passing No. 10 sieve	37% (minimum)

Soils occurring as topsoil (surface soil) shall generally not be approved.

PART 3 - EXECUTION

3.1 CONTRACTOR'S VERIFICATION

A. Excavation

Prior to the placing of any base material, examine the excavation for the grades, lines, and levels required to receive the new work. Ascertain that all excavation and compacted subgrades are adequate to receive the new work. Correct all defects and deficiencies before proceeding with the Work.

B. Subgrade Conditions

Prior to the placing of any base material, examine the subgrade to ascertain that it is adequate to receive the base to be placed. If the subgrade remains wet after all surface water has been removed, the ENGINEER OF RECORD may require the installation of edge drain.

C. Existing Improvements

Investigate and verify locations of existing improvements, including structures, to which the new work will be in contact.

Necessary adjustments in line and grade, to align the new work with the existing improvements must be approved by the ENGINEER OF RECORD, prior to any changes.

3.2 PREPARATION

A. Subgrade

The subgrade shall be fine graded to the cross section indicated on the Plans, and shall be thoroughly compacted prior to the placing of the base material.

3.3 INSTALLATION

A. General

The width, thickness and type of base materials shall be indicated on the Plans or as directed by the ENGINEER OF RECORD

No base material shall be placed until the subgrade, or subbase, or existing surface has been approved by the ENGINEER OF RECORD

B. Limerock and Shell Base Courses

The base course shall be placed by a mechanical spreader or other approved means, in uniform layers to such a depth that when compacted, the base course will have the thickness shown on the Plans.

The depth of any one (1) layer, when compacted, shall not be more than six (6) inches. If the required compaction cannot be obtained for the full depth of the base course spread, the thickness of each course shall be reduced or at the approval of the ENGINEER OF RECORD, adequate equipment shall be used to compact the aggregate to the required unit weight.

The subgrade shall be shaped to the specified crown and grade and maintained in a smooth condition. If hauling equipment causes ruts or holes in the subgrade, the hauling equipment will not be permitted on the subgrade, but shall be operated on the base course behind the spreader.

The base course shall be compacted to at least 98% of maximum unit weight as determined by AASHTO T180, by the use of approved pneumatic-tired compaction equipment or vibratory compactors.

The optimum moisture content shall be maintained until the prescribed unit weight is obtained and each layer shall be compacted until the maximum unit weight is attained before placing the succeeding layer.

When approved by the ENGINEER OF RECORD, additional water may be applied by an approved means, to the base course to aid in the compaction and shaping of the material.

Motor graders or other approved equipment shall be used to shape the base course and maintain it until the surface course is placed.

When hauling material over the base course or subgrade, the CONTRACTOR shall limit the weight and speed of his equipment to avoid damage to the subgrade or base course. If the subgrade or base course becomes rutted due to the CONTRACTORS operation, the subgrade or base course shall be removed and replaced, acceptable to the ENGINEER OF RECORD AND at the CONTRACTORS expense.

C. Limerock and Shell Stabilized Base Courses

The area to be stabilized shall have been completed to the lines shown in the plans and to a grade parallel to the finished elevation of the stabilized base, before the stabilizing material is added. The elevation of the roadbed shall be such that the base will conform to the requirements of the typical cross section when the work is completed. Any surplus excavated materials resulting from this work shall be disposed of as specified in Article 3.02 of Section 32 22 16, Earthwork for Paving.

The base material shall be mixed using a heavy-duty rotary tiller or other equipment approved by the ENGINEER OF RECORD.

The stabilizing material shall be placed on the areas to be stabilized, and spread uniformly to the loose depth shown in the plans or ordered by the ENGINEER OF RECORD. The stabilizing material shall then be thoroughly mixed with the soil. The mixing shall be done as soon as practicable but not later than one week after the stabilizing material is placed on the road. At no time shall more stabilizing material be spread in advance of the mixing operations than can be mixed in with the soil within one (1) week.

The mixing operations shall be repeated as often as may be necessary to distribute the stabilizing material uniformly throughout the soil, as determined by the testing and inspection agency and/or the ENGINEER OF RECORD. The material shall be further manipulated until uniform distribution of the stabilizing material throughout the width and depth of the base course is secured.

Mixing of the soil, limerock or shell and water may be accomplished by the central plant mix method in lieu of mixing in place, provided that a uniform mixture, containing the proper amount of water, is obtained.

After mixing is completed the surface shall be so shaped that after being compacted it will conform to the grade and typical cross section shown in the plans.

The depth of mixing of the stabilizing material shall be in accordance with the following table:

SPECIFIED BASE THICKNESS (INCHES)	REQUIRED MIXING DEPTH (INCHES)	
	MINIMUM	MAXIMUM
6	5-1/2	7-1/2
8	7-1/4	9-3/4
10	9	12

In the event that the measured depth of mixing is less than the minimum specified above, the CONTRACTOR shall remix the base course, as directed by the ENGINEER OF RECORD, until the stabilizing material is distributed throughout the base course to the required depth.

Where the measured depth of mixing exceeds the maximum limits specified in the table, the CONTRACTOR shall, at his own expense, add 1-inch, loose measure, of stabilizing material for each inch of mixing depth in excess of the allowable depth (but in no case less than 1-inch of material, for

any excess depth), and shall mix the added material in the top six (6) inches of the base, as specified above. The volume of stabilizing material, which is added, to compensate for excess mixing depth will not be included in the pay quantity, nor will any additional compensation be allowed for the extra mixing required.

After the spreading and mixing of the limerock or shell are completed, compaction shall be accomplished by rolling with either a grid-type roller or a sheepsfoot roller, properly weighted, and with water being added as required. This rolling shall be to the extent directed by the ENGINEER OF RECORD. Final rolling shall be accomplished with traffic rollers and any other compaction equipment, which will obtain the specified density.

The material shall have approximately the optimum moisture content and the proper loose consistency, as determined by the ENGINEER OF RECORD, before being compacted. Wetting or drying will be required when the material does not have the proper moisture content to insure the required density. If the material is deficient in moisture, water shall be added and uniformly mixed-in by disking the base course to its full depth. If the material contains an excess of moisture, it shall be caused to dry before being compacted. Wetting or drying operations shall involve manipulation of the entire width and depth of the base as a unit. As soon as proper conditions of moisture are attained the material shall be compacted to a density not less than 98% of the maximum density as determined by AASHTO T 180. The minimum density, which will be acceptable at any location outside the traveled roadway, such as intersections, crossovers, etc., shall be 95% of such maximum.

Each course of multiple-course base shall be compacted as specified above. Prior to the placing of material for the overlying course, the density tests shall have been made on the lower course and the ENGINEER OF RECORD shall have determined that the specified compaction requirements have been met. In the compaction of the upper course the operations of wetting, disking, etc., shall not be such as to disturb the density in the lower course. For multiple-course base the density shall be determined separately for each layer.

The areas being stabilized shall be kept well drained at all times. Wherever ruts or low spots are found the areas affected shall be brought to grade and, if necessary, shall be reshaped and recompacted. The surface of the completed stabilized base, when subjected to traffic, shall be kept moist until the prime coat is applied, so as to prevent dusting and raveling. The base shall be sprinkled with water occasionally, if so directed by the ENGINEER OF RECORD. The prime coat shall be applied only when the base meets the specified density requirements and moisture content in the top of the base does not exceed 90% of the optimum moisture for the base material. The CONTRACTOR shall maintain the stabilized base to a true and satisfactory surface and to the specified density until the wearing surface is constructed.

D. Crushed Concrete Base

The composition of the crushed concrete base material shall meet the requirements of FDOT Section 204 and FDOT Section 901-5. The placement and density of the crushed concrete base shall meet the requirements of FDOT Section 200.

The crushed concrete base course shall be placed by a mechanical spreader or other approved means, in uniform layers to such a depth that when compacted, the base course will have the thickness shown on the Plans. Spreading by other means shall be permitted only where and as directed by the ENGINEER OF RECORD.

The depth of any one (1) layer, when compacted, shall not be more than six (6) inches. If the required compaction cannot be obtained for the full depth of the base course spread, the thickness of each course shall be reduced or at the approval of the ENGINEER OF RECORD, adequate equipment shall be used to compact the aggregate to the required unit weight.

The subgrade shall be shaped to the specified crown and grade and maintained in a smooth condition. If hauling equipment causes ruts or holes in the subgrade, the hauling equipment will not be permitted on the subgrade, but shall be operated on the base course behind the spreader.

The base course shall be compacted to at least 100% of maximum unit weight as determined by AASHTO T180, by the use of approved pneumatic-tired compaction equipment or vibratory compactors.

The optimum moisture content shall be maintained until the prescribed unit weight is obtained and each layer shall be compacted until the maximum unit weight is attained before placing the succeeding layer.

When approved by the ENGINEER OF RECORD, additional water may be applied by an approved means, to the base course to aid in the compaction and shaping of the material.

Motor graders or other approved equipment shall be used to shape the base course and maintain it until the surface course is placed.

When hauling material over the base course or subgrade, the CONTRACTOR shall limit the weight and speed of his equipment to avoid damage to the subgrade or base course. If the subgrade or base course becomes rutted due to the CONTRACTOR'S operation, the subgrade or base course shall be removed and replaced, acceptable to the OWNER AND/OR THE ENGINEER OF RECORD at the CONTRACTOR'S expense.

E. Soil-Cement Base

The soil-cement mixture shall be proportioned in accordance with Strength Design or Brush Loss Criteria as set out below.

The CONTRACTOR shall submit for approval a design mix for the soil he proposes to use in soil-cement construction prepared by CONTRACTOR'S testing laboratory approved by the OWNER AND/OR THE ENGINEER OF RECORD. The design mix submittal shall include the results of tests run to verify that the soil meets the requirements set out in Article 2.01 of this Section and the results or tests used to establish the cement content. The design mix shall be submitted to the ENGINEER OF RECORD for approval a minimum of 60 calendar days prior to beginning of soil-cement construction for Brush Loss Design Method of 15 calendar days prior to beginning of soil-cement construction for Strength Design Method.

Laboratory testing for design mix evaluation shall be accomplished using water from the source proposed for use during construction.

The cement content shall be expressed in percentage of the dry-weight of the soil. For mixed-in-place construction, calculation of the rate of application of cement shall be based on the maximum density of the soil, determined in accordance with AASHTO T 99 and a thickness 1-inch greater than the thickness of the soil-cement base course shown in plans.

1. Strength Design

When the soil-cement mixture is to be proportioned in accordance with strength design, the minimum cement content shall be determined by Florida Department of Transportation Method of Test 697-007. The design compressive strength set out in the plans shall be achieved in seven (7) days. The cement content shall not be less than five (5) percent by weight.

2. Brush Loss Criteria

When the soil-cement mixture is to be proportioned in accordance with this criteria, the minimum cement content shall be determined according to AASHTO T135 (Wetting and Drying Tests of Compacted Soil-Cement Mixtures). The soil-cement loss at the completion of 12 cycles of testing shall conform to the following limits:

AASHTO Soil Groups A-1, A-2-4, A-2-5, and A-3 not over 14%.

AASHTO Soil Groups A-2-6, A-2-7, A-4, and A-5 not over 10%.

AASHTO Soil Groups A-6 and A-7 not over 7%.

The cement content shall not be less than five (5) percent by weight.

If the soil material used in producing a soil-cement mixture is being obtained from a

commercial source where soil properties are consistently uniform and the mixture is processed in a central mix plant that automatically weighs components and automatically records the weight of each component on a printed ticket, tape or other digital record the minimum five (5) percent cement content specified above shall not apply.

Before base construction operations are begun, the subgrade shall have been completed. The subgrade shall be firm enough to support the equipment used in the soil-cement base operations without appreciable distortion or displacement. Any unsuitable material shall have been removed and replaced with suitable material.

When the base is to be constructed of central plant-mix soil-cement, the subgrade shall be moist for a depth of at least 1-inch at the time the mixed course material is placed thereon.

The area over which base is to be constructed shall be graded and shaped to an elevation which will provide a base in conformance with the grades, lines, thicknesses, and typical cross Section shown on the plans. All roots, sticks, and other deleterious matter shall be removed during processing.

Mixing of the soil, cement, and water shall be accomplished either by the mixed-in-place or the central plant-mix method.

The percentage of moisture in the soil at the time of cement application shall not exceed the quantity that will permit a uniform and intimate mixture of soil and cement during mixing operations. For clay soils it shall not exceed the optimum moisture content for the soil-cement mixture. For sandy soils the moisture content shall be within two (2) percentage points above or below, the optimum moisture content. With certain types of soils, the ENGINEER OF RECORD may designate a moisture range other than those specified above.

During seasons of probability of freezing temperature, no cement or soil-cement mixture shall be spread unless the temperature is at least 40 degrees F in the shade and is rising.

At completion of moist-mixing, the soil shall be so pulverized that 100% passes a 1-inch sieve and a minimum of 80% percent passes a No. 4 sieve, exclusive of gravel or stone retained on the No. 4 sieve.

The operations specified herein shall be continuous and shall be completed within a period of four (4) hours starting from the time mixing commences.

F. Mixed in Place Soil-Cement Base

Where feasible, the entire width of the base shall be processed in a single operation. The specified quantity of cement shall be spread uniformly on the soil at the required rate of application, by means of an approved method. Spread cement that becomes displaced shall be replaced before mixing is started.

After the cement has been applied, mixing shall begin within 60 minutes unless otherwise directed by the ENGINEER OF RECORD. The soil and cement shall be initially mixed until the cement has sufficiently blended with the soil to prevent formation of cement balls when additional water is applied; then water added if necessary and the soil-cement mixture remixed.

Processing may be to full depth in one (1) course provided that satisfactory distribution of cement and water and the specified density can be obtained. If not, construction shall be in courses of such thickness that satisfactory results are obtained. Provisions shall be made to achieve adequate bonding between courses.

Immediately after mixing of the soil and cement, any additional water that is necessary shall then be added. If the moisture content exceeds that specified, the soil-cement mixture shall be manipulated by remixing or blading, as required to reduce the moisture content to within the specified range. Excessive concentrations of water shall be avoided.

During the time of application of water and after all mixing water has been applied, mixing shall continue until a uniform and intimate mixture of soil, cement, and water has been obtained.

At the option of the CONTRACTOR, as an alternative to the above-described procedure he may use an approved machine that will blend the cement and the soil and then add and mix-in any additional water that is necessary.

G. Central Mixed Soil-Cement Base

The soil, cement and water shall be mixed in a pugmill, of either the batch or continuous-flow type. The plant shall be equipped with feeding and metering devices, which will accurately proportion the soil, cement, and water in the quantities specified. Soil and cement shall be mixed sufficiently to prevent cement balls from forming when additional water is added. Mixing shall continue until a uniform and intimate mixture of soil, cement, and water is obtained. The materials shall be mixed a minimum of 30 seconds.

The mixture shall be hauled to the roadway in trucks equipped with protective covers. The mixture shall be placed on the moistened subgrade in a uniform layer by an approved spreader. Not more than 30 minutes shall elapse between the placement of soil-cement in adjacent passes of the spreader at any location, except at longitudinal construction joints. The layer of soil-cement shall be uniform in thickness and surface contour and in such quantity that the completed base will conform to the required grade and cross section. Dumping of the mixture in piles or windrows upon the subgrade will not be permitted.

Compaction of the soil-cement mixture shall begin immediately after mixing is completed. In no case shall more than 60 minutes elapse between the last pass of moist-mixing and the start of compaction of the soil-cement mixture at a particular location.

At the start of the final compaction operation, the percentage of moisture in the mixture and in unpulverized soil lumps, based on dry weights, shall not be more than two (2) percentage points above or below the optimum moisture content. The optimum moisture content and maximum density shall be determined in the field by the methods prescribed in AASHTO T 134, on representative samples of the soil-cement mixture obtained from the area being processed.

The loose mixture shall be uniformly compacted to not less than 98% of the maximum density. During compaction operations, shaping may be required to obtain uniform compaction and required grade and cross section.

After compaction, the surface of the soil-cement shall be shaped to the required lines, grades, and cross section. In all cases where soil-cement mixture is added to any portion of the surface, the surface shall be lightly scarified with a spring-tooth harrow, spike drag, or other approved device, such that the surface is uniformly loosened prior to addition of material and prior to initial set of the soil-cement mixture. The resulting surface shall then be compacted to the specified density. Rolling shall continue until all rutting ceases and until the entire base conforms to the density requirements. With certain granular soils the ENGINEER OF RECORD may determine that minor tire marks are acceptable.

The moisture content of the surface material shall be maintained at not less than two percentage points below its specified optimum moisture content, during finishing operations. Surface compaction and finishing shall be done in such manner as to produce a smooth, dense surface, free of compaction planes, cracks, ridges, and loose material.

If the time limits set forth herein are exceeded, the base shall be left undisturbed for a period of seven (7) days, after which it will be examined by the ENGINEER OF RECORD to determine its suitability. If it is found suitable the CONTRACTOR shall be fully compensated providing the base meets all other requirements specified herein. If found unsuitable the base shall be removed and replaced by the CONTRACTOR without additional compensation. The CONTRACTOR may, at his option, remove and replace the deficient base rather than wait the 7-day test cure.

At the end of each day's construction a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face. The construction joint shall be located such as to exclude all of that part of the base at the end of the run, which does not meet the requirements of the specifications and the typical Section.

After compacting and finishing have been completed, and not later than the beginning of the next calendar day after the construction of any Section of base, the surface shall be tested with a template cut to the required crown and with a 15-foot straightedge laid parallel to the centerline, and all irregularities greater than 1/4 inch shall be immediately corrected with a blade adjusted to the lightest cut which will insure a surface that does not contain depressions greater than 1/4 inch under the template or the straightedge. In the testing of the surface the measurements will not be taken in small holes caused by individual rocks having been pulled out by the blade. The material removed shall be discarded.

During the period when finishing and surface correction operations are being accomplished, the surface of the base shall be kept continuously moist by sprinkling as necessary. Subsequent to this period it shall be protected from drying for seven days, by application of either 1) cut back asphalt, Grade RC-70, applied at the rate of 0.15 to 0.20 gallon per square yard; or 2) a mixture containing equal parts of emulsified asphalt, Grade SS-1, and water, applied at the rate of 0.20 to 0.25 gallon of the diluted mixture per square yard. The actual rate of application shall be as directed and shall provide complete coverage without excessive runoff. At the time the bituminous material is applied, the soil-cement surface shall be dense, and free of all loose and extraneous material, and shall contain sufficient moisture to prevent excessive penetration of the bituminous materials.

Should it be necessary to allow construction equipment or other traffic to use the completed base before the bituminous material has cured sufficiently to prevent pickup or displacement; the bituminous material shall be sanded, using approximately ten (10) pounds of clean sand per yard.

The curing material shall be maintained by the CONTRACTOR during the 7-day protection period. No traffic shall be permitted on the base subsequent to completion of the finishing operations for a period of seven (7) days. As an exception to this requirement the equipment necessary for correction of surface irregularities, application of water and application of curing materials will be allowed provided that the tire contact pressures of such equipment does not exceed 45 pounds per square inch. After the 7-day curing period the base may be opened to traffic provided that it either is protected or has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic.

The CONTRACTOR shall maintain the base to a true and satisfactory surface until the wearing surface is constructed. Should any repairs or patching be necessary they shall extend to the full depth of the base and shall be made in a manner that will assure restoration of a uniform base course conforming to the requirements of these specifications. In no case shall repairs be made by adding a thin layer of soil-cement to the completed work. The CONTRACTOR may, at his option, make full depth repairs to small or minor areas, such as at manholes, inlets, or the like, with concrete.

H. Maintenance during Construction

The base course shall be continuously maintained in a smooth and firm condition during all phases of the construction operation.

The CONTRACTOR, at his expense, shall provide additional materials to fill depressions or bind the aggregate, when directed by the ENGINEER OF RECORD.

I. Cleanup

Immediately following the compacting of the base course, the voids on both sides of the base course shall be backfilled with sound earth of topsoil quality.

The backfill shall be compacted, leveled and left in a neat, workmanlike condition.

3.04 FIELD QUALITY CONTROL

A. Testing

During the course of the work, testing will be required for compaction or density and for thickness of material. The testing and coring required shall be performed by the CONTRACTOR'S testing laboratory approved by the OWNER AND/OR THE ENGINEER OF RECORD. The cost for testing and coring shall be at the expense of the CONTRACTOR.

A minimum of 1-depth (thickness) measurement will be made every 400 linear feet per traffic lane. The lane width shall be as indicated on the Plans. or as determined by the ENGINEER OF RECORD. If two (2) lanes are constructed simultaneously, only one (1) test is necessary to represent both lanes. For areas such as intersections, entrances, cross-overs, ramps, widening strips, acceleration and deceleration lanes, at least 1-depth measurement will be taken for each 1,200 square yards of such areas or fraction thereof. The location of the depth measurement will be at the discretion of the ENGINEER OF RECORD

B. Defective Work

1. Thickness

Measurements of base course thickness will be made to the nearest 1/4-inch. Depths may be 1/2 inch less than the thickness indicated on the Plans provided that the average of all measurements taken at regular intervals shall be equal to or greater than the specified thickness. In determining the average in place thickness, measurements, which are more than 1/2 inch in excess of the thickness indicated on the Plans, will be considered as the specified thickness plus 1/2 inch.

Locations of the depth measurements will be as specified herein unless otherwise directed by the ENGINEER OF RECORD. Sections found to be deficient in depth shall be corrected by the CONTRACTOR using methods approved by the ENGINEER OF RECORD.

2. Weight

When the aggregate material is measured by weight in tons, the pay weights for aggregates will be the scale weight of the material, including admixtures, unless the moisture content is more than six (6) percent. Moisture tests will be made at the start of weighing operations and at any time thereafter when construction operations, weather conditions or any other cause may result in a change in the moisture content of the material. If the tests indicate moisture content in excess of six (6) percent, the excess over six (6) percent will be deducted from the scale weight of the aggregate until such time as moisture tests indicate that the moisture content of the material is not more than six (6) percent.

END OF SECTION

SECTION 32 1113 - BITUMINOUS PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Scope

This Section includes bituminous paving complete with bituminous materials; bituminous mixtures; installation of bituminous base course, bituminous structural and friction courses, and bituminous curbs; construction of bituminous pavement, sidewalks, drive approaches, and tennis courts.

- B. Related Work Specified Elsewhere

- 1. Earthwork for Paving: Section 31 2216
- 2. Base Courses: Section 32 1100

1.3 QUALITY ASSURANCE

- A. Reference Standards

Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

ASTM - American Society of Testing & Materials

AASHTO - American Association of State Highway and Transportation Officials

FDOT - Florida Department of Transportation

- B. Allowable Tolerances

Following the final rolling, the surface will be tested longitudinally using a 15-foot straightedge at locations selected by the ENGINEER OF RECORD. The variation of the surface from the testing edge of the straightedge between any two (2) contacts with the surface shall at no point exceed the following limits:

For Bituminous Base Course Mixtures:

Multiple Courses: 3/8 inch for top course
3/4 inch for lower courses

For Bituminous Aggregate or Bituminous Concrete Pavement Mixtures:

Multiple Courses: 3/16 inch for top course
1/4 inch for lower courses

Single Course: 3/16 inch

Variations in excess of the specified tolerance shall be corrected as directed by the. ENGINEER OF RECORD

1.4 SUBMITTALS

- A. Reports

1. At the request of the OWNER AND/OR ENGINEER OF RECORD, the CONTRACTOR shall provide certification that the various materials to be used conform to the ASTM Standards referred to in the Specifications.
2. The CONTRACTOR shall provide the OWNER or the ENGINEER OF RECORD with the certified batch plant delivery tickets prior to the placing of the materials.
3. The CONTRACTOR shall supply the OWNER OR the ENGINEER OF RECORD with a certified job mix design for each type of bituminous mixture used on this Project.

B. Test Reports

1. Mix Design and Thickness

The testing lab shall provide the OWNER WITH (2) copies AND THE ENGINEER OF RECORD WITH (1) copy of the test results of the mix design and the thickness of the bituminous paving material. The core drilling, testing for mix design and thickness shall be performed by the CONTRACTOR'S testing laboratory approved by the OWNER'S AND/OR THE ENGINEER OF RECORD Test results shall be signed and sealed by a Professional Engineer.

1.5 JOB CONDITIONS

A. Environmental Requirements

1. Temperature

Comply with the requirements for bituminous concrete installation due to outside ambient air temperatures specified under Article 3.03 of this Section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Coarse Aggregate

The coarse aggregate gradation shall conform to ASTM D692 and to coarse aggregate as specified in FDOT, Section 901.

B. Fine Aggregate

The fine aggregate gradation shall conform to ASTM D1073, AASHTO M29, and to fine aggregate as specified in FDOT, Section 902.

C. Mineral Filler

The mineral filler gradation shall conform to AASHTO M17 and to mineral filler as specified in FDOT, Section 917.

D. Bituminous Materials

1. Asphalt Cement

Viscosity grades for asphalt cement for use in pavement construction shall conform to ASTM D3381, AASHTO M226, and as specified in FDOT, Section 916.

2. Liquid Asphalts

Liquid asphalts for use in pavement construction shall conform to ASTM D2026, D2027, and D2028, AASHTO M81 and M82, and as specified in FDOT, Section 916.

3. Emulsified Asphalt

Emulsified asphalt for use in pavement construction shall conform to ASTM D244, and as specified in FDOT, Section 916.

2.2 MIXES

A. Composition of Mixtures

Bituminous pavement mixtures shall be mixed and placed in accordance with applicable requirements specified in FDOT Sections 280, 320, 330, 331, 332, 333, 335, 337, and 339 as applicable.

The CONTRACTOR may elect to blend aggregates. When the CONTRACTOR so elects, the aggregate the composition and quality of the bituminous mixture, the blending operation, and the use of hot bins shall meet the requirements as specified herein and be approved by the ENGINEER OF RECORD. The specified aggregates, mineral filler (if required), and asphalt cement shall be combined as necessary to produce a mixture proportioned within the master gradation range limits shown in Table A and meeting the uniformity tolerance limits shown in Table C; bituminous mixtures shall also meet the mix design criteria specified in Table B.

Composition limits in Table A are shown in percent by weight, based on the total aggregate, including mineral filler, in the mixture.

The bituminous mixture specified on the Plans or in the Proposal, when tested at optimum asphalt content in accordance with ASTM D 1559, shall meet the requirements for stability, flow, and voids in mineral aggregate (VMA), as specified in Table B.

Mixtures failing to meet the requirements specified in Table B will be rejected and the CONTRACTOR will be required to submit additional samples of aggregates until a material is found which will produce a mixture meeting the Table B requirements.

If there is a change in the source of any of the aggregates, a new job-mix formula will be required.

Table A
MASTER GRADATION RANGE
FOR BITUMINOUS MIXTURES

PERCENT BY WEIGHT TOTAL AGGREGATE PASSING SIEVES*

TYPE	3/4	2	3/8	NO. 4	NO. 10	NO. 40	NO. 80	NO. 200
S-I	100	80-100	75-93	47-75	31-53	19-35	7-21	2-6
S-II**	83-98	80-100	62-78	47-63	33-49	19-35	9-18	2-6
S-III		88-100	88-100	60-90	40-70	20-45	10-30	2-6
TYPE II		90-100	90-100	80-100	55-90			2-12
TYPE III		80-100	80-100	65-100	40-75	20-45	10-30	2-10
SAHM		100						0-12
ABC-1		100						0-12
ABC-2		100			55-90			
ABC-3***	70-100			30-70	20-60	10-40		0-10
FC-2****		100	85-100	10-40	4-12			2-5
PC-1	100	88-100	75-93	47-75	31-53	19-35	7-21	2-7
PC-2			90-100	80-90	60-80	24-60	10-40	3-12
PC-3			80-100	65-90	40-75	20-45	10-30	2-10

*In inches, except where otherwise indicated. Number sieves are U.S. Standard sieve series.

**100% passing 1-1/2 inch sieve and 97-100% passing the 1-inch sieve.

***100% passing 1-1/2 inch sieve.

****The design range for the No. 10 sieve may be increased for lightweight aggregates.

Table B

MIX DESIGN CRITERIA FOR
DENSE-GRADED AGGREGATES

MIX TYPE	MINIMUM MARSHAL STABILITY (LBS.)	FLOW (0.01 IN.)	MINIMUM VMA (%)	AIR VOIDS (%)	MINIMUM EFFECTIVE ASPHALT CONTENT (%)
S-I	1,500	8-14	14	3-55.0	
S-II 1,500	8-14	13	3- 5	5.0	
S-III	1,500	8-14	15	3- 7	5.5
TYPE II	500 - 750	7-16	5-16	6.0	
TYPE III	750 - 1,000	7-16	15	5-12	5.5
SAHM	300 - 500	7-16	5-16	6.0	
ABC-1	500	7-16	15	5-16	6.0
ABC-2	750	7-16	15	5-14	5.5
ABC-3	1,000	8-14	14	3- 7	5.0
FC-2	-	-	-	-	-
PC-1	1,800	8-14	14-20	3-5	5-9
PC-2	1,000	8-16	18-30	3-7	5-9
PC-3	1,500	8-16	15-23	4-8	5-9

*If Type S-I Asphaltic Concrete is to be the final pavement surface, the range of air voids shall be four (4) percent to six (6) percent.

Table C
UNIFORMITY TOLERANCE LIMITS
FOR BITUMINOUS MIXTURE

MIXTURES TYPE	PERCENTAGE PASSING DESIGNATED SIEVES					BITUMEN CONTENT
	RANGE	3/8-IN	NO.10	NO.40	NO.200	
S-I	1*	+5.0	+5.0	+4.0	+2.0	+0.4
S-II						
S-III						
ABC-3	2**	+5.1-	+5.1-	+4.1-	+2.1-	+0.41-
FC-2		8.0	8.0	7.0	3.0	0.6
II	1*	+7.0	+5.0	+5.0	+2.0	+0.4
III						
SAHM						
ABC-1						
ABC-2	2**	+7.1-	+5.1-	+5.1-	+2.1-	+0.41-

*Range 1: Maximum allowable deviations permitted from Job Mix Formula within the Master Gradation Range.

**Range 2: Suspend mix production and make necessary changes.

***The bitumen content may exceed 0.6% above the design content but shall not exceed 0.6% above the optimum bitumen content.

After the job-mix formula is established, the aggregate gradation and the bitumen content of the bituminous mixture furnished for the Work shall be maintained within the uniformity tolerance limits permitted for the job-mix formula as specified herein under Table C, within the master gradations range as specified in Table A, and within the bitumen content specified in Table B. If two (2) consecutive aggregate gradations on one (1) sieve or bitumen contents as determined by the field extractions are not within the uniformity tolerance limits, the CONTRACTOR shall suspend all operations (work days

will be charged during the down time). Before resuming any production, the CONTRACTOR shall make all necessary alterations to the materials or plant so that the job-mix formula can be maintained within the deviations permitted under Table C, within the master gradation range shown in Table A and within the bitumen content specified in Table B.

The CONTRACTOR shall provide uniformity in the gradations of the aggregates placed in the cold feed bins so that the combination of aggregates produced for the mixture by blending the aggregates from two (2) or more cold feed bins will be uniformly fed by means of adjustable feeders onto a belt supplying the asphalt plant. The feeders shall be equipped with cutoffs which will automatically stop the operations to the asphalt plant at any time the flow of any aggregate fraction is changed so as to affect the uniformity of the finished product.

The CONTRACTOR has the option of using hot bins for proportioning the aggregates to meet the specified tolerances.

Aggregate gradation tests will be made on aggregate extracted from samples of bituminous mixture taken from the trucks. At initial start of production and at other times when tests indicate that the aggregate gradation is fluctuating, truck samples will be taken at a frequency of one (1) sample per 250 tons of mixture, but not more than four (4) samples per day. During other periods where tests indicate the aggregate gradation is stable, truck samples will be taken at a frequency of one (1) sample per 500 tons of mixture, but no more than two (2) samples per day.

The OWNER reserves the right to require the CONTRACTOR to discontinue the use of blended aggregate as provided herein and furnish graded aggregate from approved stockpiles, if in the opinion of the OWNER'S AND/OR ENGINEER OF RECORD the blended aggregate as incorporated in the bituminous mixture does not meet the requirements specified herein.

Any mixture exceeding the maximum tolerances listed in Range 2 under Table C, or exceeding the maximum limits specified for the master gradation range will be rejected.

Exact mixture proportions will be based on composite samples of aggregate and the particular bituminous material called for on the Plans and in the Proposal.

The mixture proportions shall be varied as directed by the ENGINEER OF RECORD between the limits designated in Table C, except that if highly absorptive aggregate is used, the ENGINEER OF RECORD may specify higher bitumen content without any change in the Contract unit price.

For bituminous concrete curb mixtures, asphalt additives consisting of powdered native bitumen may be used in the mixture in amounts approved by the ENGINEER OF RECORD.

PART 3 - EXECUTION

3.1 CONTRACTORS VERIFICATION

A. Excavation

Prior to the installation of any bituminous surface courses or bases, examine the excavation for the grades, lines and levels required to receive the new Work. Ascertain that all excavation and compacted subgrades are adequate to receive the bituminous concrete pavement to be installed. Correct all defects and deficiencies before proceeding with the Work.

B. Subgrade Conditions

Prior to the installation of any bituminous surface courses or bases, examine the subgrade to ascertain that it is adequate to receive the bituminous concrete pavement to be installed. If the subgrade remains wet after all surface water has been removed, the CONTRACTOR will install underdrains.

C. Surface Conditions

Prior to the installation of any bituminous mixtures for surface courses or bases, examine the surface the improvement is to be placed on and ascertain that it is adequate to receive the improvement to be installed.

D. Existing Improvements

Investigate and verify location of existing improvements, including structures, to which the new Work is to be connected. Adjustments in line and grade to align the new Work with the existing improvements must be in accordance with the CONTRACTOR's contract documents approved by the ENGINEER OF RECORD, prior to any changes.

3.2 PREPARATION

A. Preparation of Foundations

1. For bituminous base course mixtures required to be placed directly on the subgrade, the density, grade and cross section shall meet the approval of the ENGINEER OF RECORD at the time of placement of any mixture.
2. Prior to placing any bituminous mixture, the surface of the existing pavement including joints and cracks shall be thoroughly cleaned of all dirt and debris.
3. All existing structures within the limits of the new Work shall be adjusted as specified in the Plans or as directed by the ENGINEER OF RECORD.

B. Preparation of Base

Prior to the placing of any prime coats or any bituminous surface or base course mixtures, the density, grade and cross section of the subgrade or base shall meet the approval of the ENGINEER OF RECORD at the time of placement of any material. Surfaces that have become too wet or too dry shall be reworked to provide the required density.

C. Chipping Concrete Pavement for Joints

If butt joints are specified on the Plans, or by the ENGINEER OF RECORD, the old surface shall be cut back for at least five (5) feet to a depth of at least 1-inch, for the full width of the joint.

D. Edge Trimming

Trimming and truing the edge of an existing bituminous surface shall be performed as required to give a straight, sharp edge at the proper elevations.

The existing base under the bituminous surface shall be left undisturbed.

E. Removing Bituminous Surfacing

When removing an existing bituminous pavement, the edges of the area to be removed shall be cut along straight lines, either perpendicular or parallel to the direction of travel, for the full depth of the bituminous surfacing with the cut edge a minimum of 18 inches back from the disturbed edge of pavement. The cutting of the edges of the area and the breaking up of the bituminous material within the area and the removing and disposing of the unsuitable material are included in the Work of removing bituminous surfacing.

F. Removing Bituminous Patches

Where the removal of bituminous patching material is specified on the Plans or as directed by the ENGINEER OF RECORD it shall be saw cut along the edges of the patched area to prevent the tearing of the adjoining pavement surfaces during the removal operation. The cutting, removing and disposing of bituminous surfacing and unsuitable materials are included in the Work of removing bituminous patches.

G. Hand Patching

Where the filling of holes and depressions in the base or the replacing of the patches is specified on the Plans or as directed by the ENGINEER OF RECORD, the filler material shall be an approved

bituminous mixture. The mixture selected will be dependent on the depth and size of the patch and the type of mixture and penetration grade of the asphalt cement required. The patches shall be compacted to the required grade by use of a machine vibrator or approved roller.

H. Joint Clean out

Where joint Clean-out is specified on the Plans or as directed by the ENGINEER OF RECORD, the joint sealants and foreign material shall be removed to a depth of up to 1-inch by approved mechanical or hand methods. The removal and disposal of unsuitable materials and the removal and disposal of bituminous surface patches adjacent to joints are included in the Work for joint Clean out.

I. Repairing Pavement Joints

Where existing pavement joints and cracks are to be repaired, as specified on the Plans or as directed by the ENGINEER OF RECORD, the existing bituminous surface and any loose or spalled concrete around the joints and cracks shall be removed. Each joint or crack shall be cleaned and shall be filled with an approved mixture using a penetration grade asphalt and the mixture shall be compacted with a vibratory machine or by an approved method.

J. Preparation of Cover Materials

Cover materials used for seal coating shall be sufficiently dry when it comes in contact with bituminous material. The moisture content shall not exceed three (3) percent by weight, dry basis. Satisfactory means shall be provided for the protection of the coating materials against excessive moisture by covering stockpiles, by aeration or through manipulation.

3.3 INSTALLATION

A. General

1. The width, thickness and type of bituminous paving improvement shall be specified on the Plans, indicated in the Proposal or as directed by the ENGINEER OF RECORD.
2. Existing improvements, including structures, shall be protected to prevent their surfaces from being discolored during application of bituminous materials.

B. Equipment Requirements

The CONTRACTOR shall furnish sufficient equipment for the placing of the bituminous paving material and the construction of bituminous curbing. The equipment shall be on the job site and ready for normal operation before the placing of material is started. All equipment shall be in good working order. The equipment shall be subject to inspections and testing during construction. The equipment shall be of sufficient capacity that the operation can be continuous and a rate of production obtained which insures good workmanship, and eliminates overloading of the equipment or frequent interruptions or delays. The equipment shall conform to the requirements as specified in FDOT, Section 320.

1. Flasher Lights for Bituminous Concrete Equipment

On bituminous construction where traffic is being maintained, chip spreaders, distributors and rollers shall be equipped with at least one (1) approved flashing, rotating, or oscillating amber light and pavers shall be equipped with at least one (1) such light on each side of the paver. The lights shall be mounted so that the warning signal will be visible to traffic in both directions. The lights shall be in operation all the while the Work is in progress.

2. Hauling Equipment

Trucks used for hauling bituminous mixtures shall have tight, clean, smooth beds which have been thinly coated with an approved release agent, to prevent the mixture from adhering to the beds. Each truck shall have an adequately secured cover of such size and material as to completely protect the mixture from the weather and to retard the escape of heat from the mixture. Hauling units creating a hazard on the Project, or adversely affecting the quality of

the Work shall be removed from the Project.

3. Pressure Distributor

The distributor shall be mounted upon a vehicle which is capable of maintaining the uniform speeds required for proper application of the bituminous material.

The pressure distributor shall have a capacity of at least 800 gallons. It shall be equipped with heating facilities capable of maintaining the bituminous material at the specified temperature. A positive displacement type pump, installed so as to permit circulation of the material in the tank and between the tank and the spray bar, shall be provided. The pump power shall be independent of the vehicle power or the pump shall be operated by a power take-off from the vehicle motor in such a manner that uniform distribution of the bituminous material, at the rate specified, will be obtained. Full circulating spray bars shall be available for application widths of 3 to 24 feet in 1-foot increments. The nozzles shall produce a uniform fan spray, and the shutoff shall be instantaneous, with no dripping. Nozzles in various sizes between 1/8 and 1/4 inch, inclusive, shall be available.

The spray bar shall be set at the proper height to provide a uniform application at the specified coverage rate.

4. Pavers

The paver shall be an approved self-powered machine capable of spreading and finishing the mixture in a uniform layer at the desired thickness and cross section and ready for compaction. The use of any machine in poor mechanical or worn condition will not be permitted. The paver shall be of such design that the supporting wheels, treads, or other devices ride on the prepared base. The full width of surface being applied shall be screeded by an oscillating or vibrating screed. The paver shall at all times produce a uniformly finished surface, free from tearing or other blemishes that would require handwork. The screed shall be adjustable to provide for tilting to secure the proper drag or compressive action necessary to produce the desired surface texture.

The paver shall be equipped with a hopper and an automatic material-depth control device so that each distributing auger and corresponding feeder shall respond automatically to provide for a constant level of mix ahead of the screed unit to the full width of the lane being paved. In order to ensure that adequate material shall be fed to the center portion of the lane being paved, reverse pitch augers or paddles shall be installed at the inside of one (1) or both ends of the auger shafts to force the mix to the middle portion of the lane. If necessary to prevent segregation of the mix as it drops off the feed conveyor, baffle plates shall be installed at the required location.

When extensions are added to the paver, they shall be provided with the same vibrating screed or tamper action as the main unit of the paver, except for paving variable width areas.

The extensions shall also be equipped with a continuation of the automatically controlled spreading augers. The screed and any extensions shall be provided with an approved method of heat distribution.

Unless specified otherwise, bituminous pavers shall be equipped with an automatically controlled and activated screed and strike-off assembly capable of grade reference and transverse slope control. A manufacturer approved grade referencing attachment, not less than 30 feet in length, shall be used for all lower courses and the first lane of the wearing course. After the first lane of the surface course has been placed, a 10-foot, or longer, grade resurfacing attachment may be substituted for constructing subsequent adjacent lanes of surface course mixture.

A self-propelled mechanical spreader capable of maintaining the proper width, depth, and slope without causing segregation of the material, may be used for base courses and for surface courses less than eight (8) feet in width.

When surfacing ramps or shoulders, or when the grade of a concrete gutter or other existing installation must be met, the manner of use of the automatic grade reference and slope control devices shall be determined by the CONTRACTOR.

Whenever a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually for the remainder of the normal working day, provided this method of operation will produce results meeting the specification requirements.

5. Crushing Equipment

The crushing equipment shall be an approved rotary reduction machine having positive depth control adjustments in increments of 2 inch and capable of reducing material which is at least six (6) inches in thickness. The machine shall be of a type designed by the manufacturer specifically for reduction in size of pavement material, in place, and be capable of reducing the pavement material to the specified size. The cutting drums shall be enclosed and shall have a sprinkling system around the reduction chamber for pollution control. The rate of forward speed must be positively controlled in order to ensure consistent size of reduced material. The machine must be equipped with an accurate tachometer, which is mounted, in full view of the operator. The crushing equipment shall meet the approval of the ENGINEER OF RECORD.

6. Mixers

Mixers shall be self-propelled and a combination scarifier, pulverizer, mixer, and liquid distributor. Unless otherwise specified, a minimum of two (2) mixers will be required.

If asphalt cement is used as a stabilizer, one (1) mixer shall be a self-propelled single-pass stabilizer, combining a cutting rotor, a blending rotor, and at least one (1) mixing rotor in the mixing chamber.

The spray bar for distribution of the liquid shall operate in such a manner that all asphalt will be uniformly applied through the mixer at the time of mixing.

The equipment for distributing the bituminous material shall be adjustable and shall measure accurately the amounts of bituminous material being applied. The bitumen pump shall be a positive displacement type pump. It shall be equipped in such a manner as to make it possible to check accurately the rate of application of the bitumen at any time. The mixer shall meet the approval of the CONTRACTOR.

7. Joint Heaters

Joint heaters shall be infrared or other approved heaters, equipped with an automatic ignition and extinguishing system to ensure that the heater operates only when the paver is moving. It shall be of sufficient length and heating capacity to adequately soften the edge of the mat. The heater shall be oriented parallel to the joint edge. The bituminous pavement shall not be heated by a direct open flame.

8. Rollers

a. Steel-Wheel

Steel-wheel rollers shall weigh at least eight (8) tons and shall be self-propelled, vibratory or static, tandem rollers or shall be self-propelled static 3-wheel rollers. Steel-wheel rollers shall be free from backlash, faulty steering mechanism, or worn king bolts. The steering device shall respond readily and permit the roller to be directed on the alignment desired. Rollers shall be equipped with wheel sprinklers and scrapers. Roller wheels shall be smooth and free from openings or projections which will mar the surface of the pavement.

Vibratory rollers shall have a shutoff to deactivate the vibrators when the roller speed is less than 0.5 mph and shall have provisions to lock in the manufacturers recommended speed, the vibrations per minute, and the amplitude of vibration (dynamic force) for the type of bituminous mixture being compacted.

b. Pneumatic-Tired

The pneumatic-tired roller shall be of the self-propelled type with a total weight, including ballast, not greater than 30 tons. It shall be equipped with a minimum of seven (7) wheels situated on the axles in such a way that the rear group of tires will not follow in the tracks of the forward group, but will be so spaced that a minimum tire path overlap of 2 inch is obtained. The tires shall be smooth and shall be capable of being inflated to or adapted to achieve a pressure necessary to provide ground-contact pressures of at least 80 pounds per square inch. The tire pressures shall not vary by more than five (5) pounds per square inch between individual tires. The CONTRACTOR shall furnish the OWNER and ENGINEER OF RECORD charts or tabulations showing the contact areas and the contact pressures for the full range of tire inflation pressures and tire loadings for the type and size roller used.

The roller shall be equipped with a mechanism capable of reversing the motion of the roller smoothly. The roller shall be equipped with wheel sprinklers and scrapers or mats.

9. Chip Spreader

The chip spreader shall be self-propelled and shall be equipped with pneumatic tires.

The spreader shall be equipped with a screen mounted below the metering gage.

The spreader shall be capable of spreading the cover material uniformly at widths of 3 to 12 feet, or separate spreaders shall be provided for the specific widths required. The rate of discharge of the spreader shall be adjustable to spread uniform layers of 10 to 50 pounds per square yard.

10. Drag

An approved drag to level and properly distribute the cover material shall be available for use. Such a drag may be made from one (1) layer of chain link fencing eight (8) feet wide and at least ten (10) feet long, so constructed and hitched as to cover half the road width when dragged over the surface, or may be a brush broom drag of approved design.

11. Bituminous Concrete Curbing Machine

The bituminous concrete curbing machine shall be self-propelled and shall be capable of laying and satisfactorily compacting curved and straight line curb to the cross section specified on the Plans. It shall be equipped with templates for the cross sections required.

12. Miscellaneous Equipment

Sufficient equipment for handling and hauling covered material shall be provided to insure prompt and continuous covering of bituminous materials. A self-propelled power broom, straightedges for testing, thermometers, and all necessary small tools to completely and satisfactorily finish the Work shall be provided by the CONTRACTOR.

C. Bituminous Prime Coat or Bond Coat

The prepared foundation shall be treated with bituminous material for prime coat or bond coat as specified. A bond coat shall be applied to each layer of bituminous mixture before the succeeding layer is placed.

Bituminous prime coat and bond coat shall conform to the requirements of FDOT, Section 300, and as specified herein.

The bituminous material shall be applied uniformly by means of a pressure distributor, and only in such areas as may be inaccessible to the regular distributor operation shall the bituminous material be applied by means of the hand spraying apparatus of the distributor. Where necessary to accommodate traffic, the surface shall be treated half-width, or as directed by the ENGINEER OF RECORD. The foundation shall be free from moisture when the treatment is applied. Under no circumstances shall pools of bituminous material be allowed to remain on the surface.

1. Prime Coat

The amount of prime coat to be applied per square yard shall be as specified on the Plans or as directed by the ENGINEER OF RECORD.

When prime coat is applied, the surface course shall not be placed until the prime coat has been properly cured. No blotting of the prime coat with aggregate in lieu of proper curing will be permitted.

2. Bond Coat

The bond coat shall be applied at the rate specified by the ENGINEER OF RECORD. This rate will be between 0 and 0.10 gallons per square yard on the bituminous or concrete foundation and between 0 and 0.05 gallons per square yard between subsequent courses.

The bond coat material shall be applied ahead of the paving operation for a distance of at least 1,500 feet, depending on traffic conditions, as determined by the ENGINEER OF RECORD. The surfacing shall not be placed until the bond coat has cured.

D. Transportation of Mixtures

The transportation of the mixtures as specified shall be in accordance with FDOT, Sections 320-6.4 and 330-7.

E. Placing Bituminous Mixtures

Pavers will be required to have an automatically controlled and activated screed and strike-off assembly except when placing mixtures for: (1) variable width sections, (2) sections of pavement less than 1,000 feet in length, (3) placing the first course of a base course mixture on an earth grade or on a sand subbase, or (4) placing base course mixtures in widths less than eight (8) feet.

1. Placing Bituminous Base Course Mixtures

Bituminous base course mixtures shall not be placed in lifts exceeding three (3) inches unless otherwise approved by the ENGINEER OF RECORD. Approval to place lifts in excess of three (3) inches will be based on the ability of the CONTRACTOR to place and compact the base course to the required cross section and within the specified tolerances.

For lifts of 2-1/2 inches or greater, a berm of shoulder material shall be banked against the outside edge of each layer of mixture placed unless the sequence of operations is such that the edges of the material are adequately confined and supported in some other manner. The width of material placed shall be twice the height of the bituminous layer being placed but in no case less than a 6-inch width.

2. Placing Bituminous Mixtures

When the application rate for a bituminous pavement exceeds 220 pounds per square yard, the pavement shall be constructed in two (2) or more courses, unless otherwise specified on the Plans or as directed by the ENGINEER OF RECORD.

The bituminous mixture shall be placed by an approved self-propelled mechanical paver to such a depth that when compacted, it will have the thickness specified. The mixture shall be dumped into the center of the hopper and care shall be exercised to avoid overloading the paver and spilling the mixture upon the base. The paver speed shall be adjusted at the discretion of the CONTRACTOR to that speed which, in his opinion, gives the best results for the type of paver being used and which coordinates satisfactorily with the rate of delivery of the mixture to the paver to provide a uniform rate of placing the mixture without intermittent operation of the paver.

When delays result in slowing paving operations such that the temperature of the mat immediately behind the screed falls below 170 degrees F, paving shall be stopped and a

transverse construction joint placed.

Bituminous mixture shall be placed in one or more layers as called for on the Plans, or as directed by the ENGINEER OF RECORD. To take out irregularities in the existing road surface, wedging with bituminous mixture shall be done by placing several layers with the paver. Corrections to the foundation by wedging with bituminous material shall be made by placing, compacting, and allowing the material to cool prior to paving.

Bituminous mixtures shall be placed using two (2) pavers in echelon or one (1) paver equipped with an approved joint heater. The CONTRACTOR may omit the use of the joint heater if the temperature of the previously placed mat does not fall below 170 degrees F prior to placement of the adjacent course.

Echelon paving will be permitted at the direction of the ENGINEER OF RECORD.

Cold joints will be permitted along acceleration and deceleration lanes, lanes less than full width, irregularly shaped section, and at transverse joints. The edges of the initial mat for all cold joints shall be painted with bituminous material before the bituminous mixture is placed in the adjacent section. In placing the bituminous mixture adjacent to all joints, hand raking or brooming will be required to provide a dense smooth connection.

Connections with existing surfaces at the beginning and ending of resurfacing sections and at intersections shall be made by feathering out the mix, by constructing a butt joint., or as directed by the ENGINEER OF RECORD.

When placing the bituminous mixture in a lane adjoining a previously placed lane, the mixture shall be placed such that it uniformly overlaps the first lane by two (2) to four (4) inches and is placed at a height above the cold mat equal to the breakdown roller depression on the hot mat. The overlapping material shall be bumped, back onto the hot lane so that the roller will compress the excess material into the hot side of the joint. If, at the opinion of the ENGINEER OF RECORD the overlap is excessive, the excess material shall be trimmed so as to leave an edge having a uniform thickness. The excess material shall be discarded; it shall not be spread across the surface course.

If the lanes are being constructed with two or more pavers in echelon, the loose depths of bituminous material from each paver shall match at the longitudinal joints.

F. Placing Cover Coat for Sand Asphalt Bituminous Mixture

Prior to rolling a sand asphalt mixture, the CONTRACTOR shall apply a uniform coating of dry precoated sand. The rate of application for the precoated sand shall be between 0.5 and 2 pounds per square yard,, as directed by the ENGINEER OF RECORD. The precoated sand shall be uniformly applied by a mechanical spreader. Spreaders which leave ridges or mounds of the precoated sand will not be permitted. In areas where the mixture is manually placed it shall receive its initial compaction using special compacting equipment before the precoated sand is applied. The precoated sand shall then be applied and the compaction shall be completed using approved methods.

G. Rolling and Compacting of Bituminous Mixtures

Each layer of bituminous mixture shall be compacted with approved rollers. At least two (2) rollers will be required when the mixture lay-down rate exceeds 800 square yards per hour.

Steel 3-wheel rollers may be used for initial compaction immediately following the paver.

The final rolling operation on each layer of bituminous mixture shall be accomplished by use of tandem steel-wheel rollers or by use of vibratory rollers operated in the static mode.

Roller wheels shall be kept properly moistened with water.

Pneumatic-tired rollers shall be operated in a competent manner and shall not mark or rut the surface or displace the pavement edges. The pneumatic-tired roller shall be ballasted to obtain the required ground-contact pressures as directed by the ENGINEER OF RECORD. To obtain a uniformly textured

mat and the desired pavement density, the ENGINEER OF RECORD may direct the CONTRACTOR to raise or lower tire pressures at any time during the rolling operations. The roller operations shall be conducted in such a manner as to prevent scuffing or chatter marks in the pavement surface. The number of passes made by the pneumatic-tired roller shall not be less than two (2) round trip passes over each area. Rolling of the mixture shall begin as soon after placing without undue displacement, picking up the mat, or cracking. Rolling shall start longitudinally at the extreme sides of the lanes and proceed toward the center of the pavement, overlapping on successive trips by at least 2 the width of the drive wheel of the roller. Alternate trips of the roller shall be of slightly different lengths. The maximum roller speed shall not exceed the manufacturers recommended speed for the type of mixture or thickness of layer being placed.

When compacting an adjoining lane, the longitudinal joint shall be rolled first with the roller supported mainly on the cold lane with only three (3) to six (6) inches of the roller extending onto the freshly placed bituminous material.

Finish rolling with pneumatic-tired rollers shall continue until all roller marks are eliminated.

Pneumatic-tired rollers will not be permitted on friction courses.

Areas too narrow to be rolled directly by standard 8-ton tandem rollers shall be compacted by self-propelled trench rollers of suitable width, approved by the ENGINEER OF RECORD, and weighing not less than 300 pounds per inch of width.

Skin patching on an area that has been rolled will not be permitted. Any mixture that becomes mixed with foreign material or is in any way defective shall be removed and replaced at the CONTRACTORS expense.

See Article 3.04 of this Section for compaction test.

H. Weather and Seasonal Limitations

Bituminous mixtures shall not be placed nor the prime coat or bond coat applied when rain is threatening or when the moisture on the existing surface would prevent satisfactory bonding.

I. Heating Bituminous Materials

Bituminous material which requires heating before application shall be heated in such a manner as to insure a uniform temperature throughout the entire mass with efficient and positive control at all times. It shall be heated to a temperature consistent with the type of material used and only to such temperature as will insure the necessary fluidity. Excessively high temperatures shall be avoided. A thermometer shall be provided to enable the ENGINEER OF RECORD to observe the temperature at any time. Any bituminous material which has been overheated will be rejected. Asphalt emulsion shall be circulated continuously when heated above atmospheric temperature so as to prevent it from separating.

The heating of asphalt emulsion to the required temperature for application shall be done entirely in the distributor unless a uniform temperature is maintained in the storage tank by means of a circulating heater. Any asphalt emulsion which has been damaged by continuous heating for too long a time or by alternate heating and cooling will be rejected.

J. Patching

Where patching is required on a bituminous surface or concrete surface because of small holes or pitted surface, the holes shall be cleaned of all dirt and foreign material.

The bituminous patching material shall be placed, struck off and compacted so that when completed, the patch shall be flush with the adjacent pavement. The compaction may be done with a hand tamper, vibratory compactor or roller.

When patching is required for repairing a cut in the pavement, made for the construction of underground structures and utilities, the granular backfill shall be compacted to not less than 95% of the maximum unit weight. An aggregate base material of not less than 12 inches compacted thickness,

or a bituminous base of the specified thickness, shall be used.

The top of the base shall be 2 to 2-1/2 inches below the surface of the adjacent pavement. Bituminous patching material shall be placed and compacted. The surface of the bituminous patch shall be smooth and shall not vary more than 1/4 inch from the crown and grade of the adjacent pavement. Any variations over 1/4 inch from the established grade shall be corrected as directed by the ENGINEER OF RECORD

K. Seal Coating

Seal coating shall consist of one (1) or more applications of bituminous material applied to the prepared surface and one (1) or more coverings of coarse or fine aggregate applied to the bituminous material.

The bituminous materials and the aggregate to be used will be specified. The bituminous material specified for surface coat shall be uniformly applied by means of the pressure distributor in the number of applications provided and in the amount per square yard. directed by the ENGINEER OF RECORD. Each application of bituminous material shall cure sufficiently to prevent displacement or pickup by traffic or construction equipment before a succeeding application of bituminous material is made.

Following the application of surface coat bituminous material, the cover material shall be uniformly spread over the surface by means of approved mechanical spreaders, in the amount per square yard as specified. or as directed by the ENGINEER OF RECORD. Truck wheels shall ride on spread cover material and not on bituminous material.

Any irregularities or deficiencies in the uniformity of the cover aggregate on the surface shall be corrected by hand spreading and dragging.

Following the spreading of each course of cover material, the surface shall be rolled by means of approved rollers.

Rolling shall immediately follow the placing of cover material before the bituminous material has set. At no time shall there be more than 300 feet of unrolled cover material. No cover material shall be left unrolled for more than five (5) minutes.

Sufficient rolling shall be done to embed the cover material in the bituminous material without crushing the aggregate.

For areas deficient in cover material after completion of the surface treatment, additional cover material shall be added. For areas with excessive cover material, the excess cover material shall be removed before the next seal is applied. The adding and removing of cover materials shall be executed at the direction of the ENGINEER OF RECORD.

The final application of cover material shall be swept with a power broom.

The completed surface shall be maintained with a drag, broom or other approved equipment to keep the material well distributed on the road until all cover material possible has been embedded in the bituminous material. The length of time required for this maintenance will be from two (2) to five (5) days, as directed by the ENGINEER OF RECORD, depending on the weather and the materials used.

L. Bituminous Aggregate Base Course Stabilized in Place

Stabilizing of a bituminous aggregate base course, in place, shall consist of scarifying, pulverizing, crushing, adding new material, and shaping to the Plan grade for stabilizing with bituminous material, and shall include shaping, rolling, and compacting the stabilized aggregate to the proper elevation and slope.

The additional materials required shall be furnished at the CONTRACTORS expense.

The bituminous materials and the aggregates to be used shall be specified on the Plans.

1. Materials

The bituminous materials used in base course stabilization shall meet the requirements specified in Article 2.02, Mixes, of this Section, and as specified in FDOT, Section 160.

The rate of application of the bituminous material shall be determined by the ENGINEER OF RECORD, with the residual bitumen added being between two (2) percent and five (5) percent by weight of the bituminous mixture.

Additional aggregate, if required by the ENGINEER OF RECORD, shall be as specified in FDOT, Section 914.

2. Scarifying and Pulverizing

The material shall be scarified and uniformly pulverized to a maximum size of two (2) inches, except that five (5) percent of the material may be oversized, provided that the oversized material is not so large as to adversely affect the stability and structural integrity of the mixture nor hamper the shaping operations.

The material shall be scarified and uniformly pulverized, in one (1) or more passes, to the depth specified on the Plans or as directed by the ENGINEER OF RECORD.

The maximum length or width of roadbed to be scarified and pulverized at any one (1) time shall be specified on the Plans or as directed by the ENGINEER OF RECORD.

3. Grading

The crushed material shall be rough graded to within 3/4 of an inch of the grades and cross sections called for on the Plans or as directed by the ENGINEER OF RECORD. Excessive materials shall be removed and disposed of at the CONTRACTORS expense. Additional aggregate shall be placed, if necessary, to attain the required cross sections.

After the material has been balanced, it shall be thoroughly mixed. In restrictive areas, the material to be mixed may be bladed into a windrow to provide working room for the mixer.

4. Mixing with Bituminous Materials

Prior to adding the bituminous material, the moisture content of the pulverized material shall be adjusted by aerating or adding water, or as directed by the ENGINEER OF RECORD.

The bituminous material shall be added only to that material which can be completely mixed, aerated, dried, and compacted in one (1) day, and shall be added through the mixer at the rate and within the temperature range directed by the ENGINEER OF RECORD.

The aggregate-bituminous mixture shall be bladed into a windrow and mixed with the mixer, the operation proceeding from one (1) side of the Work area to the other until the mixture presents a uniform composition.

Windrowing will not be required where asphalt cement is used, nor for shoulder stabilization, unless directed otherwise by the ENGINEER OF RECORD.

5. Mixture Aeration

Aeration of asphalt emulsion mixtures shall continue until the mixture is dried to the moisture content approved by the ENGINEER OF RECORD, within the range of two (2) percent to five (5) percent, based on dry weight.

6. Shaping, Rolling, and Compacting

Rolling and compacting shall conform to paragraph 3.03.G. of this Section unless otherwise specified on the Plans or as directed by the ENGINEER OF RECORD.

Mixing, shaping, and compacting shall be done while the bituminous material is in a workable state. When asphalt cement is used, final shaping and compaction shall be accomplished

immediately after the addition of the bituminous material.

The mixed material shall be shaped and compacted in reasonably close conformity with the lines, grades, and cross sections shown on the Plans or as established by the ENGINEER OF RECORD.

Stabilized material trimmed from the grade shall be used adjacent to the shoulder to complete the cross section as shown on the Plans. Excess material shall be removed and disposed of by the CONTRACTOR at his expense.

Rolling shall be done with a pneumatic-tired roller or by a means approved by the ENGINEER OF RECORD.

The aggregate-bituminous mixture shall be compacted to not less than 98% of the unit weight obtained by the AASHTO T 180 test method. The test shall be made on the aggregate-bituminous mixture at the field moisture content existing during the compacting operation. Required density shall be maintained until the material has been surfaced.

After final rolling, the ENGINEER OF RECORD will test the surface longitudinally using a 10-foot straightedge at selected locations. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall at no point exceed $\frac{3}{4}$ inch except that where the Work consists of only stabilizing the shoulder area, the tolerance shall be $\frac{3}{8}$ inch.

7. Curing

Prior to the placing of the surface, the OWNER AND/OR ENGINEER OF RECORD may require the base be opened to traffic. At the direction of the OWNER AND/OR ENGINEER OF RECORD, imperfections in the base shall be repaired by the CONTRACTOR at his expense.

8. Weather Limitation

Bituminous material shall not be applied to the grade or to the aggregate when rain is threatening or when the air temperature is lower than 55 degrees F.

M. Bituminous Concrete Curb – Not Used

N. Bituminous Approaches, Sidewalks, and Shoulders

This Work shall consist of constructing a bituminous surface pedestrian walkway as specified on the Plans, or as directed by the ENGINEER OF RECORD. The bituminous surface course shall be placed on a prepared foundation. All bituminous surface pedestrian walkways shall have vehicular load bearing capacity.

1. Materials

The bituminous materials used shall be as specified on the Plans. Materials acceptable for use are specified in Article 2.01, Materials, of this Section.

2. Mixtures

The specific materials to produce the bituminous approach mixture shall be combined in accordance with FDOT, Section 320.

3. Preparation of Foundation

The existing pavement or base course shall be prepared to receive the bituminous surface course as specified in Article 3.02, Preparation, of this Section.

4. Prime and Bond Coats

The bituminous prime and bond coats used shall meet the requirements specified in Article 2.01, Materials, and 3.03, Installation, of this Section, and as specified in FDOT, Section 300. Care shall be taken to prevent spreading of bituminous material on adjoining surfaces. At the direction of the ENGINEER OF RECORD, the prime coat may be omitted.

5. Placing Bituminous Mixture

The bituminous mixture shall be placed to the thickness specified on the Plans or as directed by the OWNER AND/OR ENGINEER OF RECORD. Placing the bituminous mixture shall conform to Article 3.03, Installation, of this Section.

O. Cleanup

The area adjacent to the new Work shall be backfilled with sound earth of topsoil quality.

The backfill shall be compacted, leveled and left in a neat, workmanlike condition.

P. Opening Pavement to Traffic

The OWNER reserves the right to open the pavement to traffic at any time during the construction operation, with 48 hour notice on non scheduled events.

3.04 Field Quality Control

A. Testing

During the course of the Work, testing will be required for mix designs, aggregate gradation, and physical properties, bitumen content, compaction or density, and thickness of material. The testing and coring required shall be performed by the CONTRACTOR'S testing laboratory approved by the OWNER AND/OR ENGINEER OF RECORD. The cost for testing and coring shall be at the expense of the CONTRACTOR. The testing laboratory shall furnish the OWNER WITH (2) COPIES.

The ENGINEER OF RECORD shall prepare a field report describing paving and grading activities when a new activity is started or as required in the specifications Section.

Testing procedures shall conform to current FDOT Standards for Construction.

1. Bituminous Materials

Testing of asphalt cements, liquid asphalts, asphalt emulsions, tars shall conform to FDOT, Section 331.

2. Density

Rolling shall proceed until the required compaction is attained and the amount of rolling required based on the use of a nuclear gage or on using a specified minimum number of rollers. When the total tonnage for the Project is in excess of 1,000 tons, or as directed by the ENGINEER OF RECORD, the nuclear gage method will be used to govern the compactive requirements.

a. Nuclear Gage Method

By use of a modified Marshall Test, the control density for the bituminous mixture to be placed will be determined.

During the CONTRACTORS start-up operations, a rolling procedure to attain the control density will be established. The rolling procedure will be based on the number and type of rollers used and the rolling pattern. The goal of the compactive effort will be to establish a rolling procedure which will achieve 100% of the control density but in any case, the density achieved shall not be less than 95% of the control density. Density values less than 98% will be sufficient cause for the Testing Agency or ENGINEER OF RECORD to require an adjustment in the number or type of rollers being used or in the rolling pattern.

Once the procedure has been established on the start-up section, the procedure shall be used for the remainder of the mixture to be placed, unless subsequent tests indicate a need to change the number of rollers or the rolling pattern.

If difficulties are encountered or if there is a significant change in aggregate or bitumen content, the ENGINEER OF RECORD will determine the control density for the new mixture and require the CONTRACTOR to again establish the number and type of rollers and the rolling pattern required on the new mixture to attain the control density. The compactive procedures thus determined shall be used when placing the remainder of that mixture.

Density checks will be made at the discretion of the OWNER's REPRESENTATIVE to determine if the compactive procedure being used is achieving the required density, or if a change in procedure is necessary.

Each layer of bituminous mixture shall be compacted to at least 95% of the control density, using the established procedure.

B. Price Adjustments

1. Asphalt Cement

Samples of asphalt cement will be taken prior to incorporation into the mixture and from the bituminous mixture. Where results of tests on these samples deviate from specification requirements, the affected material will be subject to price adjustments on the following basis:

a. Tests on Asphalt Taken Prior to Incorporating Into the Mixture

When the penetration test results for penetration-graded asphalts, or the viscosity test results conducted at 60 degrees C on viscosity-graded asphalts, deviate from the limits specified in FDOT, Section 916, Bituminous Materials, by ten (10) percent or more, the mixture produced will be evaluated by the Testing Agency and if in the judgment of the ENGINEER OF RECORD or the OWNER the defective pavement warrants removal, the CONTRACTOR shall remove and replace the affected area at his expense. If it is determined that the removal is not required, the Contract unit price of the affected mixture will be reduced by ten (10) percent.

2. Bituminous Materials Other Than Asphalt Cement

a. Viscosity, Penetration, and Ductility Requirements

When the bituminous material in the bituminous mixture deviates by ten (10) percent or more from the requirements for viscosity, penetration, and ductility specified in FDOT, Section 916, Bituminous Materials. The ENGINEER OF RECORD will evaluate the constructed product in which the bituminous material is used. If in the judgment of the ENGINEER OF RECORD removal is required, the removal and replacement will be at the expense of the CONTRACTOR. If the ENGINEER OF RECORD determines the constructed product can remain, the Contract unit price of the bituminous mixture will be decreased by ten (10) percent.

END OF SECTION

SECTION 32 1133 - PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Scope

This Section includes both plain and reinforced Portland cement concrete paving complete with concrete material admixtures, joints, forms, equipment requirements, field quality control and appurtenances required to complete the Portland cement concrete paving Work indicated on the Plans.

Provide 4-inch thick 3,000 PSI concrete at exclusively pedestrian sidewalk areas.

- B. Related Work Specified Elsewhere

1. Earthwork for Paving: Section 31 2216
2. Base Courses: Section 32 1100

1.3 QUALITY ASSURANCE

- A. Reference Standards

Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications.

ASTM - American Society of Testing & Materials

AASHTO - American Association of State Highway and Transportation Officials

ACPA - American Concrete Paving Association

FDOT - Florida Department of Transportation

1.4 SUBMITTALS

- A. Reports

1. At the request of the OWNER OR the ENGINEER OF RECORD, the CONTRACTOR shall provide certification that the various materials to be used conform to the ASTM Standards referred in the Specifications.
2. The CONTRACTOR shall submit a list of his source of material supply to the OWNER OR the ENGINEER OF RECORD for approval prior to placing any order.
3. The CONTRACTOR shall provide the OWNER OR the ENGINEER OF RECORD, prior to the actual delivery of the ready mixed concrete, the mix design as required by paragraph 5.3.2 of ASTM C94.

- B. Test Reports

1. Thicknesses and Compressive Strength

The testing lab shall provide the OWNER with (2) copies AND ENGINEER OF RECORD (1) copy of the test results of the thickness and compressive strength of the concrete. The core

drilling, testing for thickness and compressive strength, shall be performed by the CONTRACTOR'S testing laboratory approved by the OWNER and/or the ENGINEER OF RECORD. Test results shall be signed and sealed by a Professional Engineer.

2. Water Quality

The testing lab shall provide the OWNER with (2) copies AND the ENGINEER OF RECORD (1) copy of with two (2) copies of the test results of the quality of water to be used in the concrete offsite. The sampling and testing of water quality shall be in accordance with AASHTO T-26 requirements and shall be performed by the CONTRACTOR'S testing laboratory approved by the OWNER and/or the ENGINEER OF RECORD. Test results shall be sealed by a Professional Engineer.

C. Request for Material Variance

All requests for variances in the materials, as specified, shall be made in writing to the OWNER and the ENGINEER OF RECORD. Two (2) copies of the request shall be submitted for the OWNER and the ENGINEER OF RECORD review and approval.

1.5 JOB CONDITIONS

A. Environmental Requirements

1. Temperature

Comply with the requirements for concrete installation due to outside ambient air temperatures specified under Article 3.03 of this Section.

B. Protection

1. Protection Against Rain

Comply with the requirements for protecting new Work against damage from rain, as specified under Article 3.03 of this Section.

2. Protection Against Cold Weather

Comply with the requirements for protecting new Work against damage from cold weather, as specified under Article 3.03 of this Section.

PART 2 - PRODUCTS

2.1 Materials

A. Cement

Cement shall be Portland cement conforming to ASTM C150, Type I, Type IS, or Type II as specified in FDOT, Section 921.

B. Fine Aggregates

The fine aggregate shall be silica sand meeting the requirements of FDOT, Sections 902-1 and 902-2 as applicable.

C. Coarse Aggregate

The coarse aggregate gradation shall conform to ASTM C33 and to coarse aggregate, 3M, 5 or 9, as specified in FDOT, Section 901.

D. Water

Water to be used for mixing and curing concrete shall be reasonably clean and free from oil, salt, acid,

alkali, sugar, vegetable, or other substances injurious to the finished product. Waters from sources approved by the Local Health Department as potable may be used without testing. Water requiring testing shall be tested in accordance with the current Method of Test for Quality of Water to be used in Concrete, AASHTO T-26, and specified in FDOT, Section 923.

E. Concrete Admixtures

1. Air-Entraining Admixtures

Air-entraining admixtures for concrete shall conform to ASTM C260 and as specified in FDOT, Section 924.

2. Concrete Accelerators

- a. Chemical admixtures, other than calcium chloride, for accelerating the set of Portland cement concrete shall conform to ASTM C494, Type C or Type E.
- b. Calcium chloride in flake or pellet form shall conform to ASTM D98, Grade A, Class I or Class II.

3. Water-Reducing and Water-Reducing Retarding Admixtures

Water-reducing admixtures and water-reducing retarding admixtures shall conform to the requirements as specified in FDOT, Section 924.

4. Pozzolanic Admixtures

Pozzolanic admixtures (fly ash) shall conform to ASTM C618, Type F, and as specified in FDOT, Section 345.

F. Concrete Curing Compounds

1. White Membrane Curing Compound

White membrane curing compound for curing concrete shall conform to AASHTO M148, Type II, and as specified in FDOT, Section 925.

2. Transparent Curing Compound for Base Course

Transparent membrane curing compound for curing base course concrete shall conform to AASHTO M148, Type I, and as specified in FDOT, Section 925.

G. Steel Reinforcement

1. Bar Reinforcement

Bar reinforcement for pavement tie bars and for bars for use as dowels for load transfer in pavement expansion joints and contract joints shall conform to Grade 60 of ASTM A615, and as specified in FDOT, Section 931.

2. Wire Reinforcement

Cold-drawn steel wire for concrete reinforcement used to support dowel bars shall conform to ASTM A82.

3. Mesh Reinforcement

Weld steel wire fabric for concrete mesh reinforcement shall conform to ASTM A185, and as specified in FDOT, Section 931, and shall be fabricated as shown on the Plans.

4. Bar Mat

Hard grade billet steel, hard grade axle steel or rail steel used in the fabrication of steel bar or rod mats for concrete reinforcement shall conform to ASTM A184. Steel bar or rod mats shall be fabricated as shown on the Plans.

H. Steel Hook Bolts

Hook bolts shall conform to ASTM A706, or Grade 60 of ASTM A615, A616, or A617. Hook bolts shall be 5/8 inch diameter. Along the edge of existing concrete, hook bolts with self drilling concrete anchors shall be used.

I. Joint Fillers

1. Pre-molded Joint Fillers

Pre-molded joint filler material shall be of the thickness as specified on the Plans and conforming to the requirements of FDOT, Section 932.

a. Fiber Joint Filler

Fiber joint filler material shall conform to ASTM D1751.

b. Bituminous Filler

Bituminous pre-molded joint filler material shall conform to ASTM D994 and AASHTO M33.

c. Polyethylene Filler

Polyethylene pre-molded joint filler shall be a flexible, low density, expanded, extruded polyethylene plank. The polyethylene plank shall be formed by the expansion of polyethylene base resin in an extrusion process and shall be homogeneous, closed cell and multi-cellular.

2. Hot-Poured Joint Sealants

Hot-poured type joint sealant shall conform to ASTM D3405 or D3406 and as specified in FDOT, Section 932.

3. Cold-Applied Joint Sealants

Cold-applied, single component type, joint sealant shall conform to ASTM D1850.

J. Coatings for Dowel Bars

Coatings for dowel bars shall conform to the materials as specified in FDOT, Section 350-12.4.

2.2 MIXES

A. Concrete Mix

Concrete shall contain a minimum of 5.5 sacks, 94 pounds per sack, of cement per cubic yard and shall yield a minimum compressive strength of 3,000 psi when cured in a moist room at a temperature within a range of 65 degrees to 75 degrees F for a period of 28 days.

Cement shall be Portland cement ASTM C150, Type I, Type IS, or Type II. If high-early strength concrete is desired, Type III is required.

High-early strength concrete can be obtained by the addition of 1-sack of cement, Type I, per cubic yard of concrete.

The air content of the concrete shall be from three (3) to six (6) percent. The slump of the concrete

shall be between 0 and 3-1/2 inches where machine methods are used for striking off and consolidating the concrete. If the ENGINEER OF RECORD permits hand finishing, the slump may be increased to six (6) inches.

Ready-mixed concrete shall be in accordance with ASTM C94, Alternate 2, and shall yield a minimum compressive strength of 3,000 psi when cured in a moist room at a temperature within a range of 65 degrees to 75 degrees F for a period of 28 days. The ENGINEER OF RECORD shall be provided with the mix design for review and approval, prior to the actual delivery of the concrete. Ready-mixed concrete will be certified in accordance with FDOT, Section 345-3.

PART 3 - EXECUTION

3.1 CONTRACTOR'S VERIFICATION

A. Excavation and Forming

Prior to the installation of any concrete, examine the excavation and forms for the grades, lines, and levels required to receive the new Work. Ascertain that all excavation and compacted sub-grades are adequate to receive the concrete to be installed.

Correct all defects and deficiencies before proceeding with the Work.

B. Sub-grade Conditions

Prior to the installing of any concrete, examine the sub-grade to ascertain that it is adequate to receive the concrete to be installed. If the sub-grade remains wet after all surface water has been removed by dewatering, the ENGINEER OF RECORD will require the installation of underdrain.

C. Existing Improvements

Investigate and verify location of existing improvements, including structures, to which the new Work is to be connected. Make necessary adjustments in line and grade to align the new Work with the existing improvements after approval by the ENGINEER OF RECORD.

3.2 PREPARATION

A. Forms

The forms shall be of metal, straight and free from warp, clean and of sufficient strength to resist springing during the process of depositing concrete against them.

The forms shall be the full depth of the concrete.

B. Batch Plant

An adequate site for the batch plant shall be obtained by the CONTRACTOR, at his expense. The site shall be maintained, and the plant operated in accordance with the conditions and requirements established by the community in which the plant is located.

C. Fine Grading

The sub-grade shall be fine graded to the cross section shown on the Plans and shall be thoroughly compacted prior to the placing of forms or concrete.

3.3 INSTALLATION

A. General

1. The width, thickness, and type of concrete pavement shall be specified on the Plans. or as directed by the ENGINEER OF RECORD.

2. The operation to construct the new Work shall be restricted to the existing right-of-way. If

additional area is required, the CONTRACTOR shall furnish the OWNER with written permission from the property OWNER for any part of the operation he conducts outside the established right-of-way.

3. The CONTRACTOR shall maintain traffic access at all intersections. Vehicle access shall also be maintained to all commercial and public properties and elsewhere as designated by the OWNER.

B. Equipment Requirements

The CONTRACTOR shall furnish sufficient equipment for the placing of concrete pavement. The equipment shall be on the job site and ready for normal operation before the paving operation is started. All equipment shall be in good working order. The equipment shall be subject to inspections and testing during construction.

The equipment shall be of sufficient capacity that the paver can operate continuously and obtain a rate of production that insures good workmanship and eliminates overloading of equipment or frequent interruptions or delays.

Equipment operating on or near the pavement shall be equipped with rubber-tired wheels.

1. Forms

Except when paving with a slip-form paver, forms shall be used and shall be made of metal, having an approved section, which shall insure their rigidity under impact, thrust and weight of the heaviest machine carried on them. The thickness of the metal shall be not less than 1/4 of an inch, except that a minimum thickness of 3/16 of an inch will be permitted if the form is a trapezoidal cross section.

Forms shall have a minimum length of ten (10) feet and a depth not less than the edge thickness of the Work prescribed, except as hereinafter specified for pavement with integral curb. The width of the base in direct bearing on the soil shall be not less than 0.75 of the form depth except that a width of less than eight (8) inches will not be permitted.

Forms which do not meet the required edge thickness of pavements having integral curb may be increased in depth a maximum of six (6) inches by the addition of continuous wooden planking rigidly connected to the metal form, whose base width is not less than eight (8) inches, with a minimum of five (5) equally spaced bolts. The sub-grade may be a maximum of 1-inch lower than the bottom of the built-up forms. The width of the wooden base shall be equal to or greater than the base width of the metal form, except that a nominal depth and width of less than 2" x 10" will not be permitted for the final plank in direct bearing on the soil. The wooden planking shall be sound, capable of carrying the loads imposed and shall be approved by the ENGINEER OF RECORD prior to fastening to the metal form.

When such built-up forms do not provide the necessary stability against movement along their vertical face they shall be replaced with forms capable of sustaining the loads imposed thereon.

Each 10-foot section of form shall have at least three (3) stake pockets. The forms shall be straight, free from distortion, and shall show no vertical variation greater than 1/8 of an inch in 10-foot lengths from the true plane surface on the top of the form when tested with a 10-foot straightedge and shall show no lateral variation greater than 1/4 of an inch from the true plane surface on the vertical face of the form when tested with a 10-foot straightedge.

Approved flexible forms and hand finishing will be required on all pavements where the radius for the edge of the pavement is less than 200 feet.

The method of connection between form sections shall be such that a locked joint is formed free from vertical movement in excess of 1/8 of an inch and from horizontal movement in excess of 1/4 of an inch under the impact, thrust and weight of the heaviest machine carried on the forms.

Sufficient forms shall be provided so that it will not be necessary to remove them in less than 12 hours, or longer if required, after the concrete has been placed.

2. Sub-grade Roller or Compactor

This equipment shall be self-propelled steel-wheeled or a pneumatic-tired roller weighing not less than eight (8) tons or a self-propelled vibratory compactor of adequate size to compact the sub-grade to the required density.

3. Form Grader

The form grader shall be capable of shaping the base for the forms to the proper elevation and for a width of not less than 1-foot.

A form grader is not required for construction of residential street concrete pavement.

4. Sub-grade Planer

A steel-shod sub-grade planer supported by two (2) flanged wheels resting on the side forms shall be provided for use immediately in advance of placing concrete on the sub-grade. The steel shod template shall be adjustable to fit the shape of the bottom of the pavement and shall have adequate connection to a rigid frame to maintain the crown. The planer shall be of sufficient weight to plane off all high spots encountered.

5. Base Trimmer

For slip-form construction, a base trimmer will be required. This base trimmer shall be capable of trimming the base to the required cross section.

6. Metal or Wooden Track

Metal or wooden track or duckboards capable of supporting the hauling equipment without rutting the sub-grade shall be provided in sufficient quantity to properly protect the sub-grade.

7. Water Supply Equipment

The pumps and pipe lines shall be of such capacity and nature as to insure an ample supply and adequate pressure of water, simultaneously, for all the requirements of machinery, mixing, sprinkling sub-grade, and all other requirements of the Work. Water may be supplied in tank wagons to augment inadequate pipe lines or to replace them entirely if a sufficient number of units are employed.

8. Finishing Machine

The finishing machine shall be power driven and of an approved type which will strike-off and compact the concrete with a screeding and troweling action. The machine shall be capable of finishing the concrete in the manner specified herein, and shall provide a minimum of two (2) oscillating screeds.

For construction of residential street concrete pavement a modified finishing machine with less than two (2) oscillating screeds may be used, provided that the concrete is struck off and consolidated with results which, in the opinion of the ENGINEER OF RECORD, are comparable to results obtained with a 2-screed finishing machine. Production shall be limited to 250 feet or less of 2-lane pavement per hour of continuous operation.

9. Concrete Spreader

An approved concrete spreader with a strike-off board or a separate strike-off shall be used to level each layer of concrete, before placing of reinforcement, and before finishing the concrete. It shall have sufficient weight and rigidity to retain its shape under working conditions to properly strike off the concrete.

A concrete spreader is not required for the construction of residential street concrete pavement.

10. Vibratory Screed

An approved hand-propelled vibratory screed shall be provided for use in gapped areas at driveways and intersections, where machine methods are not feasible to screed and consolidate the concrete. Gaps finished by this method shall be limited to one joint spacing in length and one (1) single lane width. The screed shall consist of a steel-shod strike board having a minimum thickness of two (2) inches and equipped with a gasoline engine capable of producing at least 5,000 vibrations per minute. Other vibratory screeds may be approved by the ENGINEER OF RECORD

11. Membrane Sprayer

A mechanically pumped pressure sprayer capable of applying a continuous uniform film of curing compound will be required. The equipment shall provide adequate stirring of the compound during application.

12. Slip-Form Paving Equipment

When pavement is placed by the slip-form method, the slip-form paving equipment shall spread, consolidate, screed, and mechanically float the freshly-placed concrete in such a manner that only a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement. The machine shall be equipped to vibrate the concrete for the full width and depth of the pavement being placed.

13. Floats

The mechanical float shall be a combination float finisher. Where a mechanical float is an integral part of a slip-form paver, a separate mechanical float will not be required.

A float finisher shall consist of a machine having two (2) screeds and be equipped with a suspended pan float. The second screed and the pan float shall be suspended in such a manner that they operate independently of the side forms.

A mechanical float will not be required for the construction of residential street concrete pavement.

14. Hand Strike Board

An approved steel-shod strike board with suitable handles for its operation shall be provided for use in areas where it is not feasible to use either a finishing machine or a vibratory screed.

15. Bulkheads

Bulkheads for construction joints shall be of lumber not less than two (2) inches nominal thickness, shaped to conform to the cross section of the pavement, and so designed as to permit dowel bars of a load transfer device, or tie bars, when required, to extend through the joint. Slots shall be cut in the header so it can be adjusted up or down as required.

16. Footbridge

A movable bridge shall be provided to satisfactorily finish the pavement. The bridge shall be designed and constructed so that it will not come in contact with the concrete.

17. Transverse Float

This float shall be made of metal and shall be at least ten (10) feet in length and of the box or channel type with a floating face at least six (6) inches in width. It shall be constructed so as to be light in weight, rigid and free from warps.

18. Vibrator

The vibrator for consolidating the concrete along the faces of the forms and adjacent to joints shall be an approved electric or mechanical vibrator of an internal type, not less than two (2)

inches in diameter. It shall have a minimum frequency of 5,000 vibrations per minute for a tube two (2) inches in diameter, 3,600 vibrations per minute for a tube four (4) inches in diameter, or a proportionate frequency of an intermediate size. A minimum of 7,000 vibrations per minute is required for speed vibrators. At least two (2) vibrators shall be provided for each concrete paving unit on the project. The vibrators used adjacent to the forms in conventional paving shall be connected with the equipment on which they are mounted such that vibration of the concrete will start automatically with the forward movement of the equipment and stop automatically whenever forward movement stops.

19. Form Tamper

A mechanical form tamper of approved design will be required on all projects. It shall be capable of thoroughly and uniformly compacting the soil under the forms.

20. Strike-Off for Reinforcement

An approved strike-off shall be used to level the concrete before placing the pavement reinforcement. It shall be adjustable and shall be supported by two (2) flanged wheels on each end which rest on the side forms. It shall have sufficient weight and rigidity to retain its shape under working conditions and properly strike off the concrete. An approved hand strike-off resting on the forms shall be used for irregular areas. The strike-off may be a part of the concrete spreader or a finishing machine.

21. Lane Tie Bar Installer

When not placed on approved chairs, lane tie bars shall be installed by use of an approved mechanical device.

22. Reinforcement Carrier

Reinforcement not placed on chairs shall be transferred from the hauling equipment to a movable bridge which spans the pavement being cast or placed by other approved means which will not result in contamination of the concrete. The bridge shall be capable of carrying the reinforcement load without appreciably deflecting the forms.

23. Joint Filling and Sealing Equipment

The equipment for filling and sealing joints shall be available for inspection and testing at least 48 hours prior to its use.

The heating kettle shall be of the indirect-heating or double boiler type, using oil as the heat transfer medium. It shall have a thermostatically controlled heat source, a built-in automatic agitator, and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath. The CONTRACTOR shall demonstrate that the equipment proposed for use will consistently produce a joint sealer of proper pouring consistency.

The hot-poured sealing materials shall be poured at the required temperature for application by the use of a separate pouring pot or from the heating kettle. The pouring equipment shall force the sealing material to the bottom of the joint and completely fill it to the surface of the pavement.

The pouring equipment shall be able to make a second application of the sealing material after the first application has cooled and settled below the surface of the pavement.

The rate of application shall be controlled so as to completely fill the joint and not spill the material on the surface of the pavement.

The hot-poured sealing material shall be applied directly from the heating kettle; the kettle shall be equipped with a pressure pump, hose and nozzle suitable for forcing the sealing material to the bottom of the joint and completely filling the joint. The hose and nozzle shall maintain the temperature of the sealing materials so that the loss in temperature is not over ten (10) degrees F between the nozzle and the heating tank. Heat from a direct flame on the nozzle shall not be used to maintain the proper temperature of the sealing material. The heating equipment shall be mounted on rubber-tired wheels, and only rubber-tired equipment shall be used to move the heating equipment on the pavement.

24. Preformed Neoprene Joint Sealing Equipment

Equipment for applying the lubricant and installing the preformed joint seal may be either power or hand operated equipment suitable for installing the joint seal as recommended by the manufacturer.

25. Sandblasting Equipment or Power Wire Brush

Sandblasting equipment shall be of proper size and capacity to obtain the cleaning specified and shall operate at a nozzle pressure adequate for the performance of the Work. Nozzles shall be of proper diameter in relation to the width of joint and shall be replaced as necessary due to enlargement by wear.

A power wire brush may be used in place of sandblasting equipment.

26. Compressors

Air compressors shall be portable and capable of furnishing sufficient air to maintain a nozzle pressure adequate to remove all loose fragments of concrete and foreign material from the joints. Suitable traps shall be employed to maintain the compressed air free of oil and moisture.

27. Power Broom

A mechanical broom with pickup suitable for cleaning the pavement will be required.

28. Concrete Saw

Two (2) self-propelled concrete saws which are adequately powered to cut hardened concrete to a minimum depth as shown on the Plans will be required. The minimum thickness of the saw blade shall be 3/16 of an inch. Saws shall be equipped with suitable guards.

29. Miscellaneous Equipment

All other small tools to completely and satisfactorily finish the Work, including straight-edges for testing pavement and forms, shall be provided by the CONTRACTOR.

C. Placement of Forms

Forms shall be placed and checked for line and grade at least 500 feet in advance of placing concrete.

Forms shall be adequately staked and braced to resist the pressure of concrete and the thrust of the equipment.

Forms shall have uniform bearing on the sub-grade throughout their entire length and width.

After setting the forms to grade, thoroughly tamp both the inside and outside with an approved mechanical form tamper.

Forms shall be thoroughly cleaned before they are placed.

Forms shall be neatly and tightly joined, and shall be securely staked by at least three (3) stakes per form.

Forms shall be oiled before concrete is placed against them.

Forms shall be checked for line and grade, after being set.

Forms showing a variance from the staked line by more than 1/4 inch or from the staked grade by more than 1/8 inch in ten (10) feet shall be adjusted.

Where the use of flexible forms are required, sufficient back bracing shall be provided to prevent undue

deflection of the forms during placement of the concrete.

D. Placing Concrete

Placing of concrete should not commence or continue until the condition of the sub-grade has been approved by the ENGINEER OF RECORD. The concrete shall be spread or distributed as soon as placed. If a mechanical spreader is not used, the concrete shall be deposited in a manner that requires a minimum of rehandling to avoid segregation and separation of materials. The concrete shall be deposited to a height sufficiently above grade so that when consolidated and finished it shall conform to the required finished grades.

Concrete along the faces of forms and adjacent to joints shall be consolidated and compacted to fill all voids.

Forms shall not be vibrated to consolidate the concrete.

When the pavement is placed in two layers, the first layer may be cast three (3) to six (6) inches narrower on each side than the proposed pavement slab, so that the full depth of pavement, at the edges, will be cast with the second layer. The equipment shall vibrate concrete placed full depth for the complete width and depth of the pavement being placed. For concrete placed in two (2) layers, only the second layer will be required to be vibrated.

The placing of concrete shall be continuous as much as possible between transverse joints.

Whenever a temporary halt in operation occurs, the concrete and unfinished end of the slab shall be covered with wet burlap or plastic.

If the interruption of Work continues for more than 20 minutes, a construction joint shall be placed, provided the proposed construction joint is 15 feet or more from the last joint for reinforced pavement and at least ten (10) feet or more from the last joint in plain concrete pavement. Sections of pavement shorter in lengths will not be permitted and, if constructed, shall be removed and replaced at the CONTRACTORS expense.

Integral curbs, where specified or required, shall be constructed monolithic with the pavement slab. The curb material shall be placed before the pavement has started its initial set and shall be of the same mix as the concrete pavement.

Base and back forms will be required when constructing straight curbs, and back forms with templates of the required curb shape shall be used when constructing rolled and mountable curbs. The curb concrete shall be spaded sufficiently to eliminate all voids and tamped to bring the mortar to the surface, after which the curb shall be given a final finish to match the texture of the pavement.

After removing forms, any visible areas of honeycomb or minor defects shall be immediately filled with mortar, having 1-part of Portland cement and two (2) parts fine aggregate, and shall be applied with a wooden float.

Where adjacent pavement lanes are constructed in separate pours, no equipment shall be operated upon recently placed concrete until the pavement has attained at least 85% of the design strength as determined by testing cores taken from the project, or until the pavement is 14 days old, at the option of the ENGINEER OF RECORD.

Any equipment wheels operating on the pavement shall operate at least 1-foot from the edge of the pavement. The equipment wheels shall be rubber-tired.

The paver shall not be permitted on the new slab until the pavement has attained full design strength. The paver shall not operate on any new slab without using wood mats having an approved thickness and width to insure that the pavement will not be marked or structurally damaged.

Pavers are not permitted to operate on residential streets.

If the curing compound is damaged, it shall be repaired by spraying additional curing compound on the damaged areas as soon as the Work is completed.

The filler strip on pavement widening projects shall be poured as soon as possible but not later than the first working day following the placing of the slab.

At all intersections and where access is required to property along the Project, construction shall be completed by gapping the proposed pavement, as directed by the ENGINEER OF RECORD. Load transfer contraction of end-of-pour joint devices shall be placed at the gapped ends of the pavement.

In lieu of pavement gapping, the CONTRACTOR may elect to place a temporary bridge, of an acceptable design approved by the ENGINEER OF RECORD, to provide access. Furnishing, placing, maintaining and removing the bridge shall be at the CONTRACTORS expense.

E. Placing Pavement Reinforcing

Where reinforcement is required, the sheets or mats shall be placed at the depth below the surface of the finished pavement, as shown on the Plans.

Pavement reinforcement shall be shipped and delivered to the Work in flat sheets or mats.

Adjacent sheets or mats shall be lapped, as indicated on the Plans, and shall be fastened to each other in no less than two (2) places in each pavement lane.

Where the width of pavement varies, the reinforcement requirements shall be the same as called for on the Plans. Split sheets or mats may be used to conform to the particular pavement configuration. Side laps shall not be less than the spacing of the longitudinal wires or bars.

On widening Projects where the pavement slab is less than six (6) feet in width, 2 inch diameter longitudinal reinforcing bars may be substituted for standard reinforcement, providing the bars are spaced not more than 12 inches center to center. The first bar shall be not more than three (3) inches from the edges of the widened slab, and the bars shall be lapped a minimum of 12 inches.

Reinforcement shall be installed by one of the following methods:

1. Chair Mounted Method

Chairs upon which reinforcement is to be mounted shall support the reinforcement and shall have such bearing on the base that there will be no undue penetration of the base. The maximum spacing of the chairs shall be sufficient to maintain the reinforcement at the specified depth. The reinforcement shall be placed directly from the hauling unit unto the chairs.

2. Two-Layer Method

When reinforcement is placed between two (2) layers of concrete, the first layer shall be mechanically spread and struck off to the required depth below the proposed finished surface for the entire width of pavement being placed. The reinforcement shall be placed directly from the carrier onto the struck off concrete.

Any area where the use of the mechanical spreader or mechanical strike-off is not feasible, the reinforcement shall be mounted on chairs.

All projects shall be bid on the basis of the chair-mounted method. Other methods of installing reinforcement may be permitted upon written authorization of the ENGINEER OF RECORD

F. Joints

All longitudinal and transverse joints shall conform to the details and shall be constructed at the locations shown on the Plans or as directed by the ENGINEER OF RECORD.

All joints shall be constructed true to line with their faces perpendicular to the surface of the pavement.

Transverse joints shall be constructed at right angles to the centerline of the pavement, unless

otherwise called for on the Plans or as directed by the ENGINEER OF RECORD. The joints shall not vary more than 1/4 of an inch from a true line.

The surface of the pavement adjacent to all joints shall be finished to a true surface. Where indicated on the Plans, joints shall be edged to the radius shown or a minimum 1/4-inch radius. The surface across the joints shall be tested with a 10-foot straightedge as the joints are finished and any irregularities shall be corrected before the concrete has hardened.

When pavement is laid in partial width slabs, transverse joints in the succeeding slabs shall be placed in line with the like joints of the first slab. In the case of widening existing pavements, transverse joints shall be placed as shown on the Plans, or as directed by the ENGINEER OF RECORD.

Keyways, where required, shall be accurately formed with templates of metal, wood, or paper securely pinned in place. The gauge or thickness of the material in the templates shall be such that the full keyway, as specified, is formed in the correct location.

1. Longitudinal Joints

Longitudinal joints shall be sawed, longitudinal lane tie joint with tie bars or bulkhead construction joints with hook bolts. Where called for on the Plans, or as directed by the ENGINEER OF RECORD, a keyway shall be constructed in the bulkhead construction joint.

a. Longitudinal Lane Tie Joints with Tie Bars

Longitudinal lane tie joints with tie bars shall be planes of weakness formed by sawing a groove in the hardened concrete according to the alignment, width and depth shown on the Plans.

Tie bars of the type, diameter and length called for on the Plans shall be placed at the required depth parallel to the finished surface, at right angles to the joint and at the uniform spacing also called for on the Plans or as directed by the ENGINEER OF RECORD.

Bar chairs shall be used to support the lane tie bars or the lane tie bars may be installed by use of a mechanical device approved by the ENGINEER OF RECORD.

The placing of lane tie bars in the concrete by hand methods will not be permitted.

The joint shall be sawed as soon as the concrete will not spall or at least three (3) days after placement, and shall be completed before traffic of any kind uses the pavement. Immediately following the sawing of the joint, the slurry resulting from the sawing operation shall be completely removed from the joint and the immediate area by flushing with a jet of water under pressure. The joint shall be blown out with a jet of compressed air to remove the flushing water. After the joint is dry it shall be cleaned out with a jet of compressed air with a working pressure of at least 90 psi and then shall be sealed with an application of an approved rubber-asphalt type compound. The sealing compound shall be applied with approved pressure type equipment with the nozzle extending into the groove and the groove shall be filled until the sealer overlaps the pavement about 1/8 of an inch.

b. Longitudinal Bulkhead Construction Joints with Hook Bolts

Longitudinal bulkhead construction joints with hook bolts shall be used in part-width construction of concrete pavement and elsewhere as shown on the Plans or as directed by the ENGINEER OF RECORD. The size, spacing and depth of the hook bolts below the surface of the pavement shall be as shown on the Plans.

For slip-form paving, lane ties of an approved type may be substituted for hook bolts and shall be spaced at 30-inch centers, unless otherwise indicated on the Plans. Lane ties for slip-form paving shall be placed in the concrete with a pneumatic powered installer or equipment producing equal results. Lane ties, which are not set with adequate consolidation of the concrete or are not within 30 degrees of being perpendicular to the pavement edge in a horizontal plane, shall be replaced with drilled in expansion anchored lane ties.

Where a bulkhead joint is to be constructed, hook bolts and couplings shall be attached to the forms and shall be held in position during the placing and finishing of the concrete so as to permit the removal of the pavement forms without damage to the concrete or hook bolt assembly. The ends of the couplings shall be protected so that the concrete, dirt or other materials cannot enter the couplings and prevent a satisfactory connection with either hook bolt.

Where hook bolts or lane ties are installed for use in future pavement widening, in curb or curb and gutter construction, a rust preventive oil shall be inserted into the open end of the couplings immediately after removal of the pavement forms by means of a hand operated pump in sufficient quantity to completely cover the internal threads. After application of the protective oil, neoprene or plastic plugs shall be inserted into the ends of the couplings to completely seal the opening without protruding outside of the couplings more than 3/8 inch.

The concrete shall be edged with a tool having the radius of curvature and depth of lip shown on the Plans. The second pour of concrete shall be edged with a longer lipped edging tool than that used on the first concrete pour.

After the concrete has cured for the required time, all extraneous material shall be removed from the joint and the joint then sealed with an approved hot poured or cold applied elastic type compound. The use of sandblasters and a jet of compressed air will be required to clean the joint before sealing.

2. Transverse Joints

Transverse joints shall be contraction joints, plane of weakness joints, dummy joints, expansion joints, construction joints, end of pour joints and pressure relief joints.

a. Contraction Joints

Contraction joints shall consist of a load transfer unit and a joint groove formed by sawing. Contraction joints shall be constructed as indicated on the Plans and shall be spaced a maximum of every 12' , or as provided for elsewhere.

The load transfer unit shall be plastic coated dowel bars, spaced and arranged in the positions indicated on the Plans, accurately held in place by an approved metal device so as to be perpendicular to the plane of the cross section of the pavement and parallel to the centerline at a distance from the surface equal to 2 the thickness of the slab.

This device shall consist of connected transverse and longitudinal members arranged to hold each dowel so firmly that its final position after concreting operations shall not vary more than 1/8 of an inch per foot of length from its designated line and grade. The device shall be such as will permit the joint to be completely assembled alongside the Work, and it shall be sufficiently rigid so that the joint can be lifted into place on the sub-grade as a unit.

One (1) end of each dowel bar shall be free to move in the slab as the concrete contracts and expands. To accomplish this, 2/3 the length of each dowel shall be thoroughly lubricated with liquid asphalt or other approved lubricant. The liquid asphalt coating shall be applied to a sawed end of the dowel bar or, in the case of dowel bars with sheared ends, a metal cap shall be placed on the coated end of the dowel bar. The coating shall be sufficiently dry before using the dowels so that it will not be removed by handling and placing the dowels in the joint. The bars shall be installed so that the alternate bar on each side of the joint shall be the coated end of the bar.

b. Plane of Weakness Joint

This joint shall be placed in plain concrete pavements only and is to be constructed immediately after the finishing operation has been completed. A groove shall be formed in the plastic concrete with a metal forming bar to the depth indicated on the Plans. A pre-

molded bituminous filler strip shall be placed in the groove formed by the metal bar, from a bridge operating on the pavement forms. The concrete shall then be floated against the sides of the filler, and the joint edged to a 1/8 inch radius.

c. Dummy Joint

This joint shall be placed in reinforced concrete payments only where called for on the Plans. It shall be constructed immediately after the finishing operation has been completed by forming a groove in the plastic concrete with a metal forming strip into which expanded polystyrene or other approved temporary filler is placed. The material shall be installed flush with the surface of the pavement and the area on both sides of the joint shall be finished. Transverse joints with a temporary filler shall not be edged. The pavement reinforcement shall be continuous through this joint.

d. Expansion Joints

This joint shall consist of a load transfer unit and pre-molded fiber filler, except that the pre-molded fiber filler without the load transfer unit shall be used for joints in concrete capping, end connections with structures or existing pavements, plain concrete pavements, and other places shown on the Plans where installation of the load transfer unit is not feasible.

The load transfer units shall be assembled and the plastic-coated bars lubricated with liquid asphalt or other approved lubricant. The liquid-asphalt-coated end of each bar shall be provided with a close fitting metal cap. The fiber filler shall extend the full depth and width of the joint. After installation, the top shall be not less than 2 inch and no more than 1-inch below the finished surface. It shall be furnished in lengths not less than the lane widths being poured. Where additional partial lengths are necessary, the minimum length of load transfer unit and pre-molded fiber filler shall be sufficient to span two (2) dowel bar spacings. Where more than one (1) section is allowed and used in a joint, the sections shall be securely joined together.

In curb lanes with integral curb, the fiber filler used in the pavement shall extend completely through the curb section. The fiber filler placed in the curb above the slab shall be 1 inch in width.

During installation, the joint shall be held in place by an approved installing device which shall be securely staked. The top edge of the filler shall be protected, while the concrete is being placed, by a metal channel cap of at least 10 gauge material having flanges not less than 12 inches in depth. The channel cap shall be shaped to the proposed crown of the pavement and shall extend over the full length of the filler.

e. Pressure Relief Joint

The method of constructing a pressure relief joint shall be as indicated on the Plans.

The pressure relief joint material shall be flexible, low-density, expanded, extruded polyethylene plank. This joint material shall be cut off to 1/2 inch below the top of the pavement surface and shall extend entirely through and to within 1/2 inch of the face and top of the curb.

f. Construction and End-of-Pour Joints Reinforced Concrete Pavement.

Construction joints in reinforced pavement shall be formed by placing a bulkhead and installing a load transfer device, as specified for contraction joints, except that the ends of the dowel bars shall not be lubricated. The load transfer device shall be so installed that each dowel bar will be embedded in the concrete for 2 of its length. When the next pour is made, a space for hot-poured rubber joint filler shall be provided by placing temporary filler in the fresh concrete. End-of-pour joints shall be constructed using 2-piece dowels and a bulkhead and shall be placed where it is anticipated that three (3) days or more will elapse between the castings of adjacent pours.

Construction and end-of-pour joints shall be sealed as specified for transverse contraction joints.

g. Construction Joints, Plain Concrete Pavement

Construction joints in plain concrete pavements shall be formed by placing a bulkhead, fiber keyway, and installing 1/2 inch diameter deformed bars, 30 inches in length, at 18 inch intervals across the end of the pavement.

The pavement across the end of both slabs shall be thickened and the joint shall be edged and sealed.

3. Transverse Joint through an Integral Curb

All transverse joints in a concrete pavement shall extend entirely through the integral curb. The material used to construct the joint in the curb shall be of the same kind as provided for the pavement.

Bituminous fiber filler shall be used to construct the expansion joints in the integral curb of reinforced concrete pavements. The thickness of the fiber filler material in the curb above the gutter shall be 1 inch. The joint material shall be pre-cut so as to conform to the geometric shape and cross sectional area of the curb, and shall be placed in intimate contact with the filler material in the pavement.

The edges of all transverse joints in the integral curb shall be rounded with an approved finishing tool, having a radius per the plans.

G. Consolidating and Finishing

The sequence of operations after the placing of concrete shall be: striking off and consolidating, floating, straight edging and finishing with burlap drag, edging and final finishing with burlap drag.

1. Striking Off and Consolidating

Mechanical methods shall be employed to strike off and consolidate or compact the concrete, except in gapped areas or where the pavement width will not permit the use of machine methods. Gaps less than one (1) joint opening in length may be finished by hand methods, provided they are finished in single lane widths.

a. Finishing Machine Method

Mechanical methods shall be employed to strike off, consolidate and compact the concrete to such an elevation that when all finishing operations are completed, the surface will conform to the required finished grade and cross section. At least four (4) inches of concrete above the finished pavement grade shall be maintained ahead of the screed for its entire length. In consolidating the surface of the pavement, on residential street construction when a single screed finishing machine is used, it shall operate over each section of the pavement twice. Only sufficient mortar shall be worked to the surface to provide a dense smooth finish. Excessive operation of the machine over a given area will not be permitted. Segregated particles of coarse aggregate which may collect in front of the screed shall be thoroughly mixed by hand with the mass of concrete already on the subgrade.

b. Hand Method

If it not possible to use mechanical equipment on irregular areas, an improved and self-propelled vibratory screed shall be employed to strike off and properly consolidate the concrete surface to the required finish grade. Where it is not possible to use a vibratory screed, a hand strike board of an approved design, will be permitted. The entire area of the pavement shall be consolidated to insure an absence of voids. Strike boards shall be moved forward with a combined longitudinal and transverse motion, with neither end raised from the side forms during the process. A slight amount of excessive concrete shall

be kept in front of the front edge at all times. When striking off and consolidating by hand, pours will be limited to single lanes or 3 of intersections.

2. Floating

After striking off and consolidating, the surface shall be made uniform by longitudinal or transverse floating by a mechanical method unless the pavement is permitted to be constructed in single lane widths.

Where mechanical floating is an integral part of the operation of a slip form paver, separate mechanical floating methods will not be required.

Mechanical longitudinal floating will not be required for residential street construction.

When mechanical equipment is not used for floating, a transverse float at least ten (10) feet in length shall be operated across the pavement by starting at the edge and slowly moving to the center and back again to the edge. The float shall then be moved ahead 1/2 of its length and the operation repeated.

Care shall be taken to preserve the crown and cross section of the pavement. The float finishing operation shall not proceed until the concrete has attained a consistency so that no excess concrete is carried ahead of the float but the entire surface can be floated and sealed.

3. Testing Surface with Straightedge and Finishing with Burlap Drag.

Immediately following the float finishes and while the concrete is still plastic, the CONTRACTOR shall test the slab surface for trueness by means of a 10 foot straightedge or acceptable float.

The straightedge shall be placed at the center of the slab with the blade parallel to the centerline and pulled slowly and uniformly to the edge. This operation shall be repeated until the surface of the concrete is free from irregularities and makes contact at all points with the bottom of the straightedge. The straightedge shall then be moved forward 1/2 its length and the operations repeated.

Depressions found the surface shall be filled with fresh concrete and consolidated by floating with a long-handled float not less than 10 feet in length. This float may also be used to smooth sections of the surface which may have become rough or torn by dragging with the straightedge.

Pavement constructed by the slip-form method, the edge settlement shall be determined as soon as practical after paving operations begin. Edge settlement in excess of 1/2 inch shall be corrected before the concrete has hardened. When edge settlements in excess of 1/3 inch persist, paving shall be suspended and operational corrections made before the ENGINEER OF RECORD will permit the resumption of paving. If the CONTRACTOR consistently fails to construct pavement within these tolerances, the use of slip-form methods shall be discontinued and pavement placed by means of conventional forms.

When paving is accomplished by the slip- form paving method, all mortar paste shall be wiped from the sides of the slab.

The surface shall then be tested for smoothness with the straightedge. During this operation, the contact of the straightedge with the concrete shall be uniform over the entire length tested. At the time of testing, the surface shall be free from soft mortar or excessive water. The testing straightedge shall be used for this purpose only.

Where the float finisher method is not utilized, as soon as the hand floating is completed, all laitance, surplus water, and inert material shall be worked entirely off the pavement and the surface made smooth by dragging with a rigid straightedge ten (10) feet in length and the surface shall be tested.

As soon as all excessive moisture has disappeared and while it is still possible to produce a uniform surface of gritty texture, the pavement shall be finished by dragging a seamless strip of damp burlap or cotton fabric, not less than five (5) feet nor more than six (6) feet in width, over the full width of the pavement. The burlap or cotton drag shall be pulled by a bridge supported

on the pavement formed. The fabric shall be renewed as often as necessary to obtain the required texture.

4. Edging and Final Finishing with Burlap Drag

Immediately after the initial finishing with burlap, the edges of the slab and all specified joints shall be finished with an edging tool to the radii indicated on the Plans. The pavement shall then be given a final finish by dragging the damp burlap or cotton fabric over that portion of the pavement disturbed by the edging operation.

H. Surface Requirements

All high spots in the surface, exceeding 1/8 inch from the straightedge but not more than 2 inch in ten (10) feet shall be removed or reduced by rubbing with a carborundum brick and water until contact with coarse aggregate is made. If contact with coarse aggregate is made, such high spots shall be removed by an approved surface grinding machine before acceptance of the pavement.

High spots in excess of 1/2 inch in ten (10) feet will be evaluated by the ENGINEER OF RECORD and if the Work is rejected, it shall be removed and replaced at the CONTRACTOR'S expense. Also, the CONTRACTOR shall take immediate steps to eliminate the cause of the defective surface.

I. Curing

After the finishing operations have been completed and immediately after the free water has left the surface, the surface of the slab shall be completely coated and sealed with uniform layer of white membranes curing compound.

The compound shall be applied in a continuous uniform film by means of mechanically pumped pressure sprayer equipment at a rate of one gallon per 200 square feet of surface. The curing compound shall not be thinned. The equipment shall provide adequate stirring of the compound during application. The equipment for applying the compound must be on the Project and approved by the ENGINEER OF RECORD before work is started.

Hand-spray equipment will be permitted only for the application of the curing compound over the sides of the slab, and for any minor damaged areas. If rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, the CONTRACTOR will be required to apply a new coat of material to the affected areas. The treated surface shall be protected by the CONTRACTOR from injury for period of at least (7) days. All traffic, either foot or otherwise, will be considered as injurious to the film of the applied compound. A minimum of foot traffic will be permitted on the dried film as necessary to properly carry on the Work including removal of any high spots, provided and damage to the film is immediately repaired by the application of a second coat of compound.

Immediately after the forms are removed, the entire area of the side of the slab shall be located with curing compound at the rate specified for the pavement surfacing.

The CONTRACTOR shall provide on the Project sufficient burlap or cotton coverings for the protection of the pavement in case of rain or breakdown of the spray equipment.

Failure to provide proper curing will be considered as sufficient cause for immediate suspension of the concreting operations.

J. Removal of Forms

Forms may be removed from freshly placed concrete after it has set for 12 hours, provided it can be done without damage to the pavement or curb edge. If during form removal the pavement or curb edge is being damaged, the form removal shall cease until the concrete has attained greater strength. The period of time for moving forms may be increased or decreased. when ordered by the ENGINEER/CONSULTANT.

Immediately after removal of the forms, the ends of all joints shall be cleaned and visible areas of honeycomb or minor defects shall be filled with mortar, composed of 1 part Portland cement and two (2) parts fine aggregate from the same source as used in the pavement, applied with a wooden float.

Immediate steps shall be taken by the CONTRACTOR to correct the conditions contributing to these defects. The sides of the pavement shall be sprayed with curing compound immediately upon removal of the forms, except where honeycombed areas are to be pointed, and then immediately cured.

Forms and pins shall not be placed on new pavement that is being cured with membrane.

K. Sawing Joints

All contraction joints, longitudinal lane-tie joints with tie-bars, and end of pour joints shall be sawed.

Joints shall be sawed before any traffic is permitted on the pavement. The concrete saw will be permitted on the pavement to saw the joints, but the water supply truck will not be permitted on the pavement until the compressive strength is not less than 3,000 psi. When permitted on the pavement, the water supply truck must be kept a minimum of 50 feet behind the sawing operation. At least two (2) approved concrete saws shall be available for use at all times, and one (1) saw shall be capable of sawing a joint groove 2 -1/2 inches deep.

The saw cut for transverse end-of-pour joints shall be made to receive the joint sealing material.

Longitudinal lane-tie joints with the tie bars shall be sawed in accordance with the alignment and dimensions indicated on the Plans.

For joints formed in one (1) operation, the joint groove shall be sawed before any transverse cracks develop. Raveling or spalling along the joint shall be repaired as specified in Section 3.0.3.L of this Section.

1. Transverse contraction joints shall be sawed in two stages:

- a. The first stage shall be a relief cut directly over the center of the load transfer assembly. The initial relief cut shall be made as soon as the saw can be placed on the freshly poured concrete, and the sawing shall continue as long as the pavement can support the saw without making or appreciably raveling of the joint.

When water is not used in the sawing operation, membranes curing compound shall be applied immediately.

When water is used in the sawing operation, the slurry resulting from the sawing operation shall be completely removed from the cut and from the immediate area by flushing with a jet of water. Additional membrane curing compound shall be applied within 12 hours after the relief cut has been made.

- b. Second stage sawing of joints shall not start until the concrete has cured for a minimum of 48 hours.

The joint groove shall be centered over the relief cut and sawed to the specified dimensions shown on the Plans plus any increase in width of the relief cut due to shrinkage or contraction the groove width tolerance shall be less than 1/16 inch.

Joints sawed without the use of water shall be blown clean of all foreign material by a jet of compressed air.

If water was used in sawing operation, the slurry resulting from the sawing operation shall be completely removed from the groove and the immediate area by flushing with a jet of water and then blown dry with compressed air.

All transverse joint grooves shall receive a final cleaning with a jet of compressed air adequate to remove all foreign material, just prior to permanent sealing.

If the specified seal is not installed within seven (7) days of final sawing, the joint groove shall be temporarily sealed with a suitable material or device to prevent the infiltration of foreign material.

Traffic shall not be permitted over the full width joint grooves prior to the installation of either the permanent seal or a temporary seal.

L. Patching Joints

After the joints have been sawed and cleaned, they shall be inspected for spalls and voids.

All loose, unsound or damaged concrete shall be removed to the satisfaction of the ENGINEER OF RECORD.

Spalls and voids will be classified as minor, intermediate or major spalls and shall be repaired accordingly.

1. Minor Spalls

Any spalls or voids which have increased the specified size of the joint groove beyond any of the following limits, but less than 36 square inches, shall be repaired by patching with an approved epoxy mortar before the seal is installed.

- a. Spalls which extend more than 1/3 inch from the joint face and over 1/2 inch below the surface of the pavement.
- b. Spalls which extend more than 1/3 inch from the joint face and two (2) inches more in length, regardless of the depth of spall below the surface of the pavement.
- c. Void areas larger than 1/2 inch in diameter in the upper 1 inch of the joint face or larger than 1 inch in diameter regardless of location.

The spalled concrete surface shall be thoroughly cleaned by sandblasting, power-wire brushing, or hand-wire brushing. The patch area shall then be blown clean with a jet of compressed air. A heavy polyethylene sheet or a rigid material shall be inserted into the joint groove and held tightly against the joint face that is to be patched.

The concrete shall be clean and dry when the epoxy resin mortar is placed.

The epoxy binder will be a mixture of two (2) parts epoxy resin to 1 part curing agent by volume.

The epoxy resin compound shall be mixed in a clean metal or polyethylene container with approved stirrer operating at 250 to 500 rpm. While the epoxy resin is being mixed, the curing agent compound shall be gradually added. The mixture shall then be stirred for a minimum of three (3) minutes until it is uniform.

After the epoxy binder is thoroughly mixed, a small portion shall be reserved for priming. The dry silica sand shall be reserved for priming. The dry silica sand shall be uniformly blended into the balance of the mixture to give an epoxy mortar of stiff or trowellable consistency. One (1) part of mixed binder to about 3.5 parts of dry sand, by volume, will usually give a workable mix.

The spalled surface shall be primed with the freshly mixed epoxy binder scrubbed into the surface with a suitable applicator to insure complete wetting and coverage of all areas to which the epoxy mortar must bond. Immediately after priming, the epoxy mortar shall be placed in the spalled area and finished to the shape of the original pavement surface. If the bond coat is not tacky when the mortar is placed, a second application shall be made. The edge of the patch shall conform to the rest of the joint groove. Dry silica sand shall be sprinkled onto the fresh epoxy mortar surface to eliminate any gloss. After the epoxy mortar has cured sufficiently so that it will not be damaged during sealing operations, the polyethylene insert shall be carefully removed. All joints shall receive a final cleaning with a jet of compressed air to remove all foreign material.

When the temperature of the air and the pavement is above 50 degrees F, the hot-poured elastic type joint seal may be placed on the day following the placing of the epoxy resin

mortar patch. When the temperature of the air and the concrete is below 50 degrees F, the time of curing required for the epoxy mortar shall be as determined by the ENGINEER OF RECORD.

2. Intermediate Spalls

Any spalls larger than 36 square inches but not extending below the reinforcing mat shall be repaired by sawing and chiseling out the unsound concrete and patching with Portland cement mortar.

A saw cut at least 1-inch deep shall be made parallel to the joint groove at the outer extremity of the spalled area. The concrete shall be chipped out to the saw cut so that a vertical face is present at the back of the repair area, and the two (2) ends of the repair area shall be trimmed to approximately vertical faces.

The area to be repaired shall be sandblasted to remove all loose particles and then blown clean with a jet of compressed air to remove the sand and all other foreign materials. The repair area shall be flushed with clean water and the excess water shall be blown out with compressed air.

A heavy polyethylene sheet or a rigid material shall be inserted into the joint groove and held tightly against the joint face that is to be patched.

The bottom and vertical faces of the repair area shall be primed with a grout of creamy consistency made with a 1:1 mixture of Portland cement and silica sand with water.

The prime coat will be scrubbed into the surface with a suitable applicator to insure complete wetting and coverage of all areas to which the Portland cement mortar must bond. The cement grout shall be carefully applied to the rough surfaces of the spall area and shall be applied immediately prior to placing of fresh mortar so that the prime coat is wet when covered by mortar.

The Portland cement patching material shall be tamped into the repair area and finished level to the pavement surface. This Portland cement mortar shall consist of 1-part Portland cement to two (2) parts silica sand with a water content of not more than four (4) gallons per sack of cement. A liquid air-entraining agent to maintain an air content of 8% to 11% shall be added. Calcium chloride in an amount of one (1) percent of the cement content may be added as an accelerator, if approved by the ENGINEER OF RECORD.

The edge of the patch at the joint face shall conform with the rest of the joint groove. White membrane curing compound shall be sprayed on the patch surface immediately after the mortar is cast and finished. After 72 hours the polyethylene form shall be carefully removed and all patched joints shall receive a final cleaning with a jet of compressed air to remove all foreign material.

3. Major Spalls

When a joint is damaged beneath the depth of the reinforcing mat, it shall be considered a major repair. These major repairs shall be handled on an individual basis under the direction of the ENGINEER OF RECORD.

M. Sealing Joints

All transverse expansion, contraction, construction and longitudinal bulkhead construction joints shall be filled and sealed with an approved hot-poured elastic type compound. All longitudinal lane-tie joints shall be pressure filled and sealed with either an approved hot-poured or cold-applied elastic type compound. These sealing compounds shall not be placed when the atmospheric or pavement temperatures are less than 50 degrees F or when the weather is rainy or foggy.

1. Sealing Transverse Expansion, Contraction, End-of-Pour and Longitudinal Bulkhead Construction Joints

After the shoulders are completed and the pavement has cured, the joints and pavement surfaces on each side of the joints shall be cleaned of all extraneous matter. The cleaning shall be done by sandblasting or other methods approved by the ENGINEER OF RECORD that will be equally effective in cleaning the concrete. The dust and sand present after the sandblasting or cleaning shall be removed by a jet of compressed air. Hand tools shall be used to remove stones and other foreign materials from the joint groove.

Immediately after the joints are cleared with the compressed air, and with the surface of the concrete in the joint dry, the joint shall be sealed with an approved hot-poured elastic type compound.

The hot-poured compound shall be melted in an approved double boiler type kettle. Direct heating will not be permitted. Also, any sealing material heated in excess of the safe heating temperature shall not be used in the Work.

During the process of pouring the joints, the ENGINEER OF RECORD may, at his discretion, require that sufficient compound be taken from the melting unit to make flow tests. The ENGINEER OF RECORD may require that to modify his method of heating or of charging the heating unit with compound that will produce satisfactory results.

Pouring shall be from the melting kettle equipped with an approved pressure pump hose and nozzle. When authorized by the ENGINEER OF RECORD, The sealing compound may be poured with a hand-type pouring pot for curbs and short miscellaneous joint lengths, provided a satisfactory joint is obtained. Pouring of the sealing compound shall be done so as to fill the joint to 1/4 inch below top of pavement. Any sealing compound spilled on the surface of the pavement shall be removed immediately. After the first pour has cooled to the temperature of the pavement and settled, a second pour shall be made to bring the sealing compound to 1/4 inch of the surface of the pavement.

Traffic shall not be permitted over the poured joint until the compound has hardened sufficiently to rest pickup.

2. Sealing Longitudinal Lane-Tie Joints

All longitudinal land-tie joints shall be cleaned and immediately filled with either an approved hot-poured or cold-applied elastic type compound. The sealing compounds shall be applied with pressure equipment, capable of completely filling the joint.

To protect hot-poured and cold-applied sealing compound while it is curing and to prevent pickup by traffic, the sealed joint shall be covered with a strip of paper, 1-1/2 inches wide, or other approved means, immediately following application of the compound. The paper strip shall be left in place until worn off by traffic.

N. Traffic Control

All measures necessary to protect and maintain traffic and to protect the Work shall be in accordance with FDOT, Section 102.

O. Protection Against Rain

The CONTRACTOR shall adequately protect the new concrete from the effects of rain before the concrete has sufficiently hardened. For this Work, the CONTRACTOR shall have available on the job site at all times enough burlap or 6-mil thick polyurethane film to cover and protect one day's Work. When rain appears eminent, all operations shall stop and personnel shall begin covering. As soon as the rain ceases, the concrete shall be uncovered and the surface burlap dragged where necessary. Curing compound shall be applied to any areas where the compound has been disturbed or washed away. Protection of the new concrete against rain shall be at the CONTRACTOR'S expense.

P. Cold Weather Protection

Any time there is a danger of temperatures falling below 35 degrees F, the CONTRACTOR shall have available on-site a sufficient amount of clean, dry straw or hay or polyethylene film or other approved

materials to cover at least one (1) day's production. Cold weather protection shall be at the CONTRACTOR'S expense. The source of the temperature shall be taken from forecasts prepared by the local weather bureau, recognized as the Official Weather Bureau for the area the new Work is being constructed. The predicted low temperature shall be that forecast to occur during the next 24 hours.

1. General

To accelerate hardening of the concrete when the temperature of the air in the shade and away from artificial heat is between 45 degrees F and 40 degrees F, calcium chloride shall be added to the mix at the rate approved by the ENGINEER OF RECORD. The calcium chloride shall be spread on the materials immediately before discharging into the drum of the mixer. A method approved by the ENGINEER OF RECORD, shall be used for measuring the amount of dry calcium chloride to be added to each batch of concrete. The calcium chloride shall not be placed in contact with the cement.

Immediately after finishing of the concrete and as soon as hardening of the concrete will permit, the pavement shall be covered and the protective covering shall remain in place until the concrete has developed a compressive strength of not less than 3,000 pounds per square inch or for a minimum period of 14 days or as directed by the ENGINEER OF RECORD.

The protective covering shall be placed around and over the forms and it shall extend beyond the edge of the pavement for a distance at least equal to the depth of covering required.

When removing forms, the protective covering should be removed for as short a time as possible and should be replaced promptly to prevent loss of heat.

The mixing and placing of concrete shall stop in sufficient time each day to permit finishing of the concrete and the placing of the required protective covering during daylight hours or as directed by the ENGINEER OF RECORD.

The requirements specified herein for the curing and protection of concrete in cold weather is minimum requirements, and the CONTRACTOR shall be responsible for the quality and strength of the concrete placed. Any concrete injured by frost action shall be removed and replaced at the CONTRACTOR'S expense.

2. Ordinary Protection

When the predicted low temperature is to be below 35 degrees F at any time within 72 hours after placing the pavement, the pavement shall be protected and such protective covering shall remain in place until the concrete has developed a compressive strength of not less than 3,000 pounds per square inch, or for a minimum period of 14 days or as directed by the ENGINEER OF RECORD.

3. Special Protection

The temperature of the concrete at the time it is placed on the subgrade shall be not less than 50 degrees F, or more than 85 degrees F.

In order to maintain a mix temperature between 50 degrees F and 85 degrees F, the mixing water on the aggregates, or both, shall be heated as required by the ENGINEER OF RECORD. The water and the aggregates shall be heated to a temperature of not more than 150 degrees F. The heating of aggregates shall be done by the use of steam pipe under the aggregate piles, or by free steam discharge into the aggregate piles, or by steam pipe in the batching bins. The heating of the water and the aggregates shall be controlled so that there will not be any large differences in temperature from batch to batch. The ENGINEER OF RECORD will determine the method to be used in heating the aggregate.

When there is any danger of the predicted low temperature dropping below 35 degrees F, all the necessary materials for covering and protecting the concrete, equipment for heating the water and aggregates, when required, and calcium chloride shall be on the Project and available for

immediate use for the required method of curing and cold weather protection before any pavement is placed.

When temperatures are such that special protection is required as specified above, all concrete placed within the preceding 72 hours shall be similarly protected.

When special protection is started, it shall be continued until design strength is reached in accordance with the above requirements unless warmer temperatures prevail for a period of at least 48 hours. Permission to eliminate special protection for such a period shall be as directed by the ENGINEER OF RECORD.

Protection of the new concrete against cold weather including ordinary and special protection shall be at the CONTRACTOR'S expense.

Q. Concrete Temperature Limitations

Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees F. Methods for controlling the temperature shall be submitted for the review and approval of the ENGINEER OF RECORD prior to their use.

R. Curb Drop

Curb drops shall be provided for existing and future sidewalk ramps, for approaches for existing driveways and at other locations as directed by the ENGINEER OF RECORD.

Curb drops for sidewalks shall be in accordance with the current rules and regulations of the Florida Department of Transportation. Curb drops for drive approaches shall be centered with the existing driveway at the property line.

The width of the residential curb drop shall be equal to the width of the driveway determined at the property line plus four (4) feet. Unless otherwise directed by the CONTRACTOR ENGINEER OF RECORD, the minimum width of the residential curb drop shall be 14 feet.

S. Shoulders

The shoulders shall be constructed according to the lines, grades and cross section shown on the Plans and as specified for the particular type of shoulder material required. The shoulders shall be done in such sequence with the surfacing operations that they will be completed not more than seven (7) days after the expiration of the curing period, unless otherwise directed by the ENGINEER OF RECORD.

T. Cleanup

After the concrete has gained sufficient strength, but no sooner than within 12 hours, the fixed forms shall be removed and the spaces on both sides shall be immediately backfilled with sound earth of topsoil quality. The backfill shall be compacted, leveled and left in a neat, workmanlike condition.

At a seasonally correct time approved by the ENGINEER OF RECORD the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded or sodded.

U. Opening Pavement

The OWNER, reserves the right to require that curing operations be discontinued when the concrete has reached 85% of the design strength, and to require that the shoulders be completed and the slab be opened to traffic.

3.4 Field Quality Control

A. Testing

1. During the course of Work, testing will be required of standard test cores and cylinders, by the CONTRACTOR'S testing laboratory approved by the OWNER. The cost of testing and coring

shall be at the expense of the CONTRACTOR.

For each lane of Work:

- a. A minimum of one (1) cylinder for testing compressive strength shall be made for each 500 linear feet, or fraction thereof., or as directed by the ENGINEER OF RECORD.
- b. A minimum of two (2) cores for testing compressive strength and for checking thickness shall be drilled each 500 feet, or fraction thereof.

The making of cylinders, the drilling of cores and testing shall be at the expense of the CONTRACTOR.

Slump tests for consistency of Portland cement concrete shall be made in accordance with ASTM C143 and C172.

2. Defective Work

In the event the test results on a core indicates a deficiency in either thickness or compressive strength or in the event the test results on a cylinder indicates a deficiency in compressive strength, the following adjustments in the unit price for concrete shall be made based on the average of three (3) cores:

- a. Thickness:

Under Required Thickness	Percent of Reduction in Unit Price
0" to 1/4"	None
by more than a 1/4", but not exceeding a 2"	20
by more than a 2", but not exceeding 1"	50
by more than 1"	Remove and Replace

- b. Compressive Strength

Under Required Compressive Strength	Percent of Reduction in Unit Price
0 to 150 psi	None
by more than 150 psi, but not exceeding 300 psi	20
by more than 500 psi	Remove and Replace

Other places shown on the Plans where installation of the load transfer unit is not feasible.

The load transfer units shall be assembled and the plastic-coated bars lubricated with liquid asphalt or other approved lubricant. The liquid-asphalt-coated end of each bar shall be provided with a close fitting metal cap. The fiber filler shall extend the depth and width of the joint. After installation, the top shall be not less than 2 inch and no more than 1-inch below the finished surface. It shall be furnished on lengths not less than the lane widths being poured. Where additional partial lengths are necessary, the minimum length of load transfer unit and pre-molded fiber filler shall be sufficient to span two (2) dowel bar spacings. Where more than one (1) section is allowed and used in a joint, the sections shall be securely joined together.

Reduction in the unit price are additive, that is if an area is deficient by 3/8 of an inch and is under strength by 200 psi, the total reduction is 20% or a reduction of 40%.

The area of a deficient core shall be determined by the drilling and testing of two (2) additional cores, one (1) on each side of the deficient core and 20 feet from it, when possible.

The extra core drilling and testing shall be at the CONTRACTOR'S expense.

END OF SECTION

SECTION 32 1313 - CONCRETE SIDEWALKS AND SLABS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

- A. Furnish all labor, material equipment and transportation and perform all work necessary for the construction of the sidewalks/walkways and slabs to the lines and grades as shown on the Construction Drawings. Also, please reference the Geotechnical Report. Information provided within the geotechnical report supersedes this specification.

1.3 SUBMITTALS

- A. Submit certificates by the producers or manufacturers that the furnished materials meet the specific requirements of the Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete: Class I (3000 psi) as specified in the FDOT Standard Specifications for Road and Bridge Construction, Latest Edition, Section 345.
- B. Reinforcement: Steel bars and welded wire fabric conforming to the requirements of FDOT Standard Specifications for Road and Bridge Construction, Latest Edition, Section 415.
- C. Preformed Joint Filler: Non-extruding and resilient bituminous type conforming to the requirements of ASTM D 1751.
- D. Membrane Curing Compound: Clear fugitive dye conforming to the requirements of AASHTO M 148, Type 1-D, Class A.
- E. Vapor Retarders: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade Condition:
 - 1. Maintain the finished subgrade in a smooth, compact condition and restore any areas which are disturbed prior to placing of the concrete. Uniformly apply water ahead of the pouring operations as directed by the Engineer to keep the subgrade moist at the time the concrete is placed. Remove large boulders and other obstructions to a minimum depth of 6-inches below the finished subgrade elevation, and backfill the space with sand, base course material or other suitable material thoroughly compacted by rolling or tamping.
 - 2. Trim the subgrade accurately to the required elevation with a 1/4-inch tolerance. Trim high areas to proper elevation. Fill low areas with suitable material and compact to the specified density, or fill with concrete integrally with the placing of the pavement.
- B. Setting Forms: Set the forms accurately to line and grade and so that they rest firmly, throughout their entire length, upon the compacted subgrade surface. Join forms neatly and tightly and brace them to resist the pressure of the concrete and the finished operations. Obtain the Engineer's approval for the alignment and grade of all forms before and immediately prior to the placing of concrete.

- C. Slipforming: The slipforming method will be allowed, provided that an acceptable finished product, true to line, grade, and cross section is consistently produced.
- D. Mixing Concrete: Mix in accordance with the requirements of the FDOT Standard Specifications for Road and Bridge Construction, Latest Edition, Section 345.

3.2 INSTALLATION

- A. Placing Concrete:
 - 1. Distribute the concrete on the subgrade to such depth that, when it is consolidated and finished, the thickness required by the Drawings will be obtained at all points and the surface will at no point be below the grade specified for the finished surface. Deposit the concrete on the subgrade in a manner which will require as little rehandling as possible and is continuous between transverse joints, without the use of intermediate bulkheads.
 - 2. Place reinforcement as shown on the Drawings and maintain at this location during the placing and finishing operations.
 - 3. Thoroughly consolidate concrete against and along the faces of all forms by means of vibrators. Do not permit vibrators to come in contact with the subgrade or a side form, or vibrate at any one location so long as to produce puddling or the accumulation of excessive grout on the surface. Do not operate the vibrator longer than 15 seconds in any one location.
- B. Striking-off, Consolidating and Finishing Concrete: Immediately after the placing, strike off, consolidate and finish the concrete to produce a finished product conforming to the cross section, width and surface finish required by the Drawings and Specifications.
- C. Straightedging and Surface Corrections:
 - 1. After floating has been completed and the excess water removed, but while the concrete is still in a plastic state, test the surface of the concrete for trueness with an accurate 10-foot straightedge. Hold the straightedge in successive positions parallel to the centerline, in contact with the surface, and test the whole area from one side of the slab to the other as necessary. Advance along the walkway in successive stages of not more than one-half the length of the straightedge. Immediately fill any depressions with freshly mixed concrete and strike-off, consolidate and refinish. Cut down high areas and refinish. Continue straightedge testing and surface correction until the entire surface appears to conform to the required grade and cross section. Correct all surface irregularities exceeding 1/4-inch in 10-feet.
- D. Final Finish: As soon as the water sheen has disappeared and just before the concrete becomes non-plastic, finish all edges, including expansion joint edges, with an edging tool having a radius of ½-inch. Finally give the top a light broom finish perpendicular to the forms.
- E. Joints:
 - 1. Transverse Construction Joints: Construct at the end of all pours and at other locations where the pouring operation are stopped for as long as 30 minutes, but not within five feet of any other transverse joint or of either end of a section of walk or slab. If sufficient concrete has not been placed to form a slab at least five feet long, remove the excess concrete, back to the last preceding joint. Form the joints by placing a wood or metal bulk-head accurately and securely in place, in a plane perpendicular to the profile and centerline of the walk or slab. Tool edges of construction joints with a 1/8-inch radius.
 - 2. Transverse Control Joints: Form at appropriate intervals as planes of weakness created by an edging tool. Cut the fresh concrete perpendicular to the surface of the walk or slab, to a depth of 1/4 to 1/3 the depth of the slab.
 - 3. Transverse Expansion Joints: Form by placing preformed joint filler, one-half inch thick, around all structures and at intervals not exceeding 100 feet.

- F. Curing:
1. After the finishing operations have been completed and as soon as the concrete has hardened sufficiently that marring of the surface will not occur, cover the entire surface and the edges of the newly placed concrete and cure with membrane curing compound.
 2. Apply curing compound uniformly to the surfaces to be cured, in a continuous film, at the rate of application and in the manner recommended by the manufacturer.
 3. Do not apply the curing compound during periods of rainfall. Should the film become damaged from any cause within the required curing period, immediately repair the damaged portions with additional compound. Upon removal of side forms immediately coat the sides of the slabs exposed, providing a curing treatment equal to that provided for the surface.
- G. Form Removal: After the concrete has sufficiently set a minimum of 12-hours, remove the forms and backfill the space on each side. Compact and grade the earth in a satisfactory manner without damage to the concrete work. Fill honeycombs with sand cement mortar. Plastering will not be allowed on the face of the walk or slab. Remove rejected walk or slab and replace without additional compensation.
- H. Note: Install vapor retarder under all covered concrete sidewalks. Install vapor retarder sheets according to ASTM E 1643. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

END OF SECTION

SECTION 32 1613 - CONCRETE CURB

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. The work included in this Section consists of furnishing all labor, material equipment and transportation for the construction of the curb, curb and gutter, and traffic separator to the lines and grades as shown on the Drawings.

1.3 SUBMITTALS

- A. All materials specified shall be certified by the producer or manufacturer that the furnished material meets the specific requirements of the specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete: Concrete shall be Class B that conforms to the requirements of FDOT Standards.
- B. Reinforcing Steel And Welded Wire Fabric: Reinforcing steel bars and welded wire fabric shall conform to the requirements of FDOT Standards.
- C. Preformed Joint Filler: Preformed joint filler shall be non-extruding and resilient bituminous type and shall conform to the requirements of AASHTO 153 or AASHTO Designation M 213.
- D. Joint Sealer for Gutters:
 - 1. Hot Poured Type: Joint sealer shall conform to the requirements of AASHTO Designation M 173. Cold Applied Type: In lieu of the hot poured type, joint sealer shall be a one or two part polysulfide base self leveling sealant for horizontal surfaces that has been developed for foot and vehicular traffic. The sealant shall be listed on the Thiokol approved product list.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade Condition:
 - 1. The finished subgrade shall be maintained in a smooth, compact condition and any areas which are disturbed prior to placing of the concrete shall be restored at the Contractor's expense. The subgrade shall be moist at the time the concrete is placed. Water shall be uniformly applied ahead of the pouring operations as directed by the Owner's Engineer.
 - 2. The subgrade shall be accurately trimmed to the required elevation with a 1/4 inch tolerance. High areas shall be trimmed to proper elevation. Low areas may be filled with suitable material and compacted to the specified density or filled with concrete integrally with the placing of the pavement.
- B. Setting Forms: The forms shall be accurately set to line and grade and such that they rest firmly, throughout their entire length upon the compacted subgrade surface. Forms shall be joined neatly and tightly and braced to resist the pressure of the concrete and the finished operations. The alignment and grade of all forms shall be approved before and immediately prior to the placing of concrete.

- C. Slipforming: The slipforming method will be allowed, provided that an acceptable finished product, true to line, grade, and cross section is consistently produced.
- D. Mixing Concrete: Concrete shall be mixed in accordance with the requirements of FDOT Standards.

3.2 INSTALLATION/APPLICATION

A. Placing Concrete:

- 1. The concrete shall be distributed on the subgrade to such depth that, when it is consolidated and finished, the thickness required by the Drawings will be obtained at all points and the surface will at no point be below the grade specified for the finished surface. The concrete shall be deposited on the subgrade in a manner which will require as little rehandling as possible. Placing of the concrete shall be continuous between transverse joints, without the use of intermediate bulkheads.
- 2. Reinforcement shall be placed as shown on the Drawings and shall be maintained at this location during the placing and finishing operations.
- 3. Concrete shall be thoroughly consolidated against and along the faces of all forms by means of vibration. Tamping or vibration at any one location shall not continue so long as to produce puddling or the accumulation of excessive grout on the surface.

B. Striking-Off, Consolidating And Finishing Concrete:

- 1. Immediately after the placing, the concrete shall be struck off, consolidated and finished, to produce a finished product conforming to the cross section, width and surface finish required by the Drawings and Specifications.
- 2. After the concrete has sufficiently set a minimum of 12-hours, the Contractor shall remove the forms and shall backfill the space on each side. The earth shall be compacted and graded in a satisfactory manner without damage to the concrete work. Honeycombs shall be filled with sand cement mortar. Plastering will not be allowed on the face of the curb. Rejected curb, curb and gutter or valley gutter shall be removed and replaced without additional compensation.

C. Final Finish: As soon as the water sheen has disappeared and just before the concrete becomes non-plastic, a light broom finish shall be given to the surface.

D. Joints:

- 1. Transverse Construction Joints: Transverse construction joints shall be constructed at the end of all pours and at other locations where the pouring operation are stopped for as long as 30 minutes. Construction joints, however, shall not be placed within ten feet of any other transverse joint or of either end of a section of curb. If sufficient concrete has not been placed to form a slab at least ten feet long, the excess concrete, back to the last preceding joint, shall be removed. The joints shall be formed by placing a wood or metal bulk-head accurately and securely in place, in a plane perpendicular to the profile and center line of the pavement. Construction joints shall be sawed, in a manner similar to contraction joints, so that a groove will be formed for holding the joint sealing compound.
- 2. Transverse Contraction Joints: Transverse contraction joints shall be constructed at ten foot intervals and shall consist of planes of weakness created by sawing the surface of the hardened concrete. The cut shall be perpendicular to the surface of the pavement, and shall extend to a depth of six inches below the top of the curb and one and one-half inches below the gutter.
 - a. It shall be the Contractor's responsibility to see that the sawing equipment does not damage the curb and to saw the transverse contraction joints as soon as the curb, curb and gutter has hardened to the degree that tearing and raveling are not excessive and before uncontrolled shrinkage cracking begins. If, at any time, uncontrolled cracking occurs, the Contractor will be required to modify his methods.

3. Transverse Expansion Joints: One-half inch expansion joints shall be formed by placing preformed joint filler at the ends of each radius return, around all structures, and at intervals not exceeding 500 feet.
4. Cleaning And Sealing Joints: Joints in gutters which are to be sealed, shall be filled with joint sealing material before the roadway is opened to traffic and as soon after completion of the curing period as is feasible. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign material (including any membrane curing compound) and the joint faces shall be clean and surface-dry when the sealer is applied.
 - a. The sealing material shall be applied to each joint to conform to the details shown on the Drawings and in accordance with the manufacturer's recommendation. The pouring shall be done in such manner that the material will not be spilled on the exposed surfaces of the concrete. Any excess material on the surface of the concrete gutter shall be removed immediately and the gutter surface cleaned.

All cracks occurring in the gutter prior to its acceptance shall be cleaned out and sealed as specified above, except that the cracks and fractures shall be completely filled with joint sealer and any excess filler material cut down level with the gutter surface.

E. Curing:

1. After the finishing operations have been completed and as soon as the concrete has hardened sufficiently that marring of the surface will not occur, the entire surface and the edges of the newly placed concrete shall be water cured by misting or covering with a double thickness of burlap, cotton mats, or other approved material kept thoroughly saturated with water.
2. The forms shall be kept wet until removed and upon removal, the curing specified herein shall be started immediately.
3. Concrete shall be cured for a period of seven (7) days for normal Portland cement or four (4) days for high early strength cement.
4. Concrete poured in the dry shall not be submerged until it has attained sufficient strength to adequately sustain the stress involved, nor shall it be subjected to flowing water across the surface for four (4) days.

END OF SECTION

SECTION 32 1723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. This Section specifies the furnishing and application of permanent reflective pavement marking traffic paints, thermoplastic, glass spheres and reflective pavement markers.

1.3 QUALITY ASSURANCE

- A. Pavement marking traffic paints, thermoplastic, glass spheres and reflective markers shall be applied in accordance with Hillsborough County Standards and Specifications for Road and Bridge Construction, latest edition, of the Florida Department of Transportation, the Manual of Uniform Traffic Control Devices and the Florida Manual on Traffic Control and Safe Practices for Street and Highway Construction and Supplemental Specifications thereto.

1.4 SUBMITTALS

- A. Submit certificates stating that materials meet Florida Department of Transportation Specifications Sections 706, 711, 971-12, 971-13 and 971-14.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. White and Yellow Permanent Reflective Pavement Markings Paint: Traffic paint codes T1 (white) and T2 (yellow) shall meet with requirements of Section 971-12 in the FDOT Standard Specifications for Road and Bridge Construction.
- B. Thermoplastic: The thermoplastic compound used shall meet the requirements set of Section 711 of the FDOT Standard Specifications for Road and Bridge Construction.
- C. Markers: Reflectorized pavement markers shall meet the requirements of Section 706 of the FDOT Standard Specifications for Road and Bridge Construction.

END OF SECTION

SECTION 32 3019 - TRAFFIC SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. This Section specifies the furnishing and installation of permanent roadway signs, sign supports, reflectorized delineators, reflector buttons, reflective sheeting and their associated hardware.

1.3 QUALITY ASSURANCE

- A. Roadway signs, sign supports, reflectorized delineators, reflector buttons, reflective sheeting and their associated hardware shall be in accordance with the following:
 - 1. The Standard Specifications for Road and Bridge Construction, (latest edition) Florida Department of Transportation supplemental specifications thereto.
 - 2. Manual of Uniform Traffic Control Devices for Street and Highway Construction Maintenance and Utility Operations.
 - 3. FDOT Manual on Traffic Controls and Sage Practices for Street and Highway Construction Maintenance and Utility Operations.
 - 4. Standard Highway Signs Manual published by the U.S. Department of Transportation.
 - 5. Reference Guide: Standard Alphabets for Highway Signs and Pavement Markings, published by the U.S. Department of Transportation.

1.4 SUBMITTALS

- A. Submit certificates stating that the roadway signs, sign supports, reflectorized delineators, reflector buttons, reflective sheeting and their associated hardware meet the specifications of the publications as specified in Section 1.02A above.
- B. Submit certificates stating that the street name signs and their associated hardware meet the requirements of the local government agency having jurisdiction or as shown on the drawings, whichever is more stringent.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Signs, sign supports, reflectorized delineators, reflector buttons, reflective hardware sheeting and their associated hardware shall be in accordance with the requirements of the publications as specified in Section 1.02-A above.

PART 3 - EXECUTION

3.1INSTALLATION

- A. Install all roadway signs, sign supports, reflectorized delineators and reflector buttons in accordance with the requirements of the Standard Specifications for Road and Bridge Construction, (latest edition) of the Florida Department of Transportation, the Manual of Uniform Traffic Control Devices and supplemental specifications thereto.
- B. Install all street name signs in accordance with the requirements as noted on the drawings or of the local governmental agency having jurisdiction, whichever is more stringent, providing there is no conflict with the Florida Department of Transportation specifications or regulations.

END OF SECTION

SECTION 32 3119 - DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Decorative aluminum fences.
- 1.2 RELATED REQUIREMENTS
 - A. Section 03 3000 - Cast-in-Place Concrete.
- 1.3 REFERENCE STANDARDS
 - A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - C. ASTM D523 - Standard Test Method for Specular Gloss.
 - D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
 - E. ASTM D822/D822M - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
 - F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
 - G. ASTM D2244 - Standard Practice for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
 - H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
 - J. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets.
- 1.4 SUBMITTALS
 - A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
 - B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - C. Shop Drawings:
 - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
 - D. Manufacturer's Qualification Statement.
 - E. Installer's Qualification Statement.
 - F. Manufacturer's Warranty.
- 1.5 QUALITY ASSURANCE
 - A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
 - B. Source Limitations for fences and gates: Obtain fences and gates from one source with resources to provide fences and gates of consistent quality in appearance and physical properties.
 - C. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.
- 1.6 DELIVERY, STORAGE AND HANDLING
 - A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.
- 1.7 WARRANTY
 - A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
 - A. Decorative Metal Fences and Gates:
 - 1. Ameristar Perimeter Security, USA; Echelon Plus - Majsetic (Basis of Design):
www.ameristarperimeter.com/#sle.
- 2.2 FENCES
 - A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:

- B. Electro-Deposition Coating: Multistage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
 - 1. Total Coating Thickness: 2 mils, minimum.
 - 2. Color: As selected by Architect from manufacturer's standard range.
 - 3. Coating Performance: Comply with general requirements of ASTM F2408.
 - a. Adhesion: ASTM D3359 (Method B); Class 3B with 90 percent or more of coating remaining in tested area.
 - b. Corrosion Resistance: ASTM B117, ASTM D714 and ASTM D1654; 1/8 inch coating loss or medium No.8 blisters after 1,500 hours.
 - c. Impact Resistance: ASTM D2794; 60 inch pounds.
 - d. Weathering Resistance: ASTM D523, ASTM D822/D822M and ASTM D2244; less than 60 percent loss of gloss.
- C. Aluminum: ASTM B221.
 - 1. Tubular Pickets, Rails and Posts: 6005-T5 alloy.
 - 2. Extrusions for Posts and Rails (Outer Channel): 6005-T5 alloy.
 - 3. Extrusions for Pickets and Rail (Inner Slide Channels): 6063-T5 alloy.

2.3 ALUMINUM FENCE

- A. Decorative Aluminum Fence System: Provide fence meeting the Test Load and Coating Performance requirements of ASTM F2408 for Industrial class.
- B. Fence Panels: 6 feet high by 8 feet long.
 - 1. Panel Style: refer to drawings.
 - 2. Attach panels to posts with manufacturer's standard panel brackets and recommended fasteners.
- C. Posts: Aluminum extrusions; 2-1/2 inches square.
 - 1. Size: 2-1/2 inches square.
 - 2. Extrusion Wall: 0.120 inch thick.
 - 3. Internal Reinforcing: 0.080 inch thick.
- D. Rails: Extruded aluminum channels.
 - 1. Double-walled aluminum U-channel; outside cross-section dimensions of 1-3/4 inch square; interior guide channel forms lower limit of raceway for retaining rod.
 - 2. Effective Wall Thickness:
 - a. Top Wall of Outer Channel: 0.100 inch thick.
 - b. Side Wall: 0.120 inch thick.
 - 3. Enclosed Retaining Rod: 1/8 inch diameter galvanized steel with variable pitch connection system for high angle racking and elimination of external fasteners.
 - 4. Picket-to-Rail Intersection Seals: PVC grommets.
 - 5. Picket Spacing, Standard: 3-7/8 inch on center.
- E. Pickets: Extruded aluminum tubes.
 - 1. Spacing: 3 7/8" inch on center.
 - 2. Style: Pickets with finial extend above top rail.
- F. Fasteners: Manufacturer's standard stainless steel bolts, screws, and washers; factory finish fasteners to match fence.
- G. Gates: Match ornamental fencing. Provide:
 - 1. Locking latch.
 - 2. Heavy Duty hinges.
 - 3. Cane bolt.
- H. Accessories: Aluminum castings, extrusions, and cold-formed strips; factory finished to match fence.
 - 1. Flat post cap.
- I. Color: As selected by Wilder Architecture, Inc. from manufacturer's standard range.
- J. Products:
 - 1. AFS, Inc. - Vanguard Aluminum Fences; Vertical Privacy T&G: www.americanfencesystem.com/#sle.
 - 2. Ameristar Perimeter Security, USA; Echelon II: www.ameristarfence.com/#sle.
- K. Decorative Aluminum Privacy Fence and Swinging Gates:
 - 1. Fence Panels: Formed aluminum sheets; 5 feet high by 6 feet long.
 - 2. Posts: Aluminum extrusions; 3 inches square.
- L. Decorative Aluminum Cantilever Gates:
 - 1. Gate Panels: Manufacturer's standard decorative aluminum fence panels.
 - 2. Posts: Aluminum extrusions; 2 inches square.
 - 3. Rails and Frame: Welded aluminum extrusions; 2 inches by 3 inches.
 - 4. Match ornamental fence aesthetic.
 - 5. Operation: Where required in plans provide operator..
 - a. Operator: Slide Dive 40 by HySecurity.

2.4 SPECIALITY HARDWARE

- A. Hinges: Finished to match fence components.
 - 1. Closing: Manual.
 - 2. Material: Steel.
- B. Latches: Finished to match fence components.
 - 1. Mechanism: Gravity.
 - 2. Locking: Mechanical.
 - 3. Material: Steel.
 - 4. Provide a cane bolt at each gate l
 - 5. Products:
 - a. Strong Arm lockable latch.

2.5 LOUVER GATES

- A. Manufacturer: Ametco Manufacturing.
- B. Eclipse design (Basis of Design).
- C. Material: extruded aluminum, welded. 6063 extrusion. Powder coat finish.
 - 1. Main bars: formed extruded aluminum.
 - a. 2-1/16" centers.
 - 2. Cross bars.
 - a. 18" centers.
 - 3. Color: as selected by architect from full range of colors.

2.6 ACCESSORIES

- A. Keypad Mounting Supports: Where not factory installed, provide mounting supports for keypad installation.
 - 1. Products:
 - a. StrongPoles, LLC; Architectural Keypad Pedestal: www.strongpoles.com/#sle.
- B. Caps: Aluminum alloy; sized to post diameter, set screw retainer.
- C. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Wilder Architecture, Inc. of unsatisfactory preparation before proceeding.
- C. Verify layout information for fences and gates shown on Drawings in relation to existing conditions. Verify dimensions in field.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Set fence posts in accordance with the manufacturer recommended spacing.
- C. When cutting rails immediately seal the exposed surfaces by:
 - 1. Removing metal shavings from cut area.
 - 2. Apply zinc-rich primer to thoroughly cover cut edge and drilled hole; allow to dry.
 - 3. Apply two coats of custom finish spray paint matching fence color.
 - 4. Failure to seal exposed surfaces in accordance with manufacturer's instructions will negate manufacturer's warranty.
- D. Space gate posts according to the manufacturers' drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.
 - 1. Base type and quantity of gate hinges on the application, weight, height, and number of gate cycles.
 - 2. Identify the necessary hardware required for the application on the manufacturer's gate drawings.
 - 3. Provide gate hardware by the manufacturer of the gate and install in compliance with manufacturer's recommendations.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From Indicated Position: 1 inch.
- C. Minimum Distance from Property Line: 6 inches.

3.5 FIELD QUALITY CONTROL

- A. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.
- B. Gates: Inspect for level, plumb, and alignment.
- C. Workmanship: Verify neat installation free of defects.

3.6 CLEANING

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- B. Clean fence with mild household detergent and clean water rinse well.
- C. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.
- D. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

3.7 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 32 4870 – SODDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including Contractual Conditions and Division Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes provisions for the following items: Sodding and Seeding Lawns, Soil Preparation, Initial Maintenance and acceptance of Sodded areas.

1.3 QUALITY ASSURANCE

- A. Analysis and Standards: Package products with manufacturer's certified analysis. For other materials provide analysis by recognized laboratory made with methods established by the Association of Official Agriculture Chemists, wherever applicable.
- B. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration while stored at site.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Contractual Conditions and Division One Specification Sections:
 - 1. Product Data: Manufacturer's data including installation and storage instructions for each product specified as follows.
 - 2. Submit seed and sod grower's certification of grass species. Identify source location.
 - a. Submit certificates of inspection as required by governmental authorities and manufacturers or vendors certified analysis for soil amendments, herbicides, insecticides and fertilizer materials; submit other data substantiating that materials comply with specified requirements.

1.5 JOB CONDITIONS

- A. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Landscape Architect before sodding or seeding.
- B. Installer must examine Sub grade, verify elevations, and observe conditions under which work is to be performed, and notify Project Manager of unsatisfactory conditions. The installer shall not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

PART 2 - PRODUCTS

2.1 LAWNS

- A. Install Argentine Bahia sod in the locations shown on the plans. Obtain sod from areas having growing conditions similar to areas to be covered. Sod shall have a clean growth of acceptable grass, reasonably free of weeds, with not less than 1 1/2" of soil firmly adhering to roots. Cutting shall be rectangular strips, of equal width, and a size to permit being lifted and rolled without breaking. All broken sod pads, irregularly shaped pieces, torn or uneven ends will be rejected. Sod installation shall be done within 48 hours after the time of harvesting.
- B. Install Argentine Bahia seed in the locations shown on the plan. Seed shall be fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysis "Rules of Testing Seeds" for purity and germination tolerances.
- C. Seed Mixture: Provide certified grass seed blends or mixes, proportioned by weight, as follows:

Scarified Bahia	- 2.3 pounds per 1,000 S.F.
Bermuda	- 2.3 pounds per 1,000 S.F.
Brown Top or Rye	- 4.0 pounds per 1,000 S.F. (depending on season of seed installation)

PART 3 – EXECUTION

3.1 PREPARATION FOR SODDING AND SEEDING

- A. Loosen sub grade of lawn areas to a minimum depth of 4 inches. Remove stones over 1 1/2" in any dimension. Remove sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.

- B. Spread soil to minimum depth required meeting lines, grades, and elevations shown, after light rolling and natural settlement.

3.2 SODDING ARGENTINE BAHIA LAWNS

- A. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Avoid damage to sod during installation. Tamp or roll to ensure contact with sub-grade, eliminate air pockets, and form a smooth surface. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.
- B. Water sod thoroughly with a fine spray immediately after planting. During the sod establishment period, set irrigation to water daily or as frequently as necessary to maintain moist soil to a minimum depth of 1 1/2" below the sod.

3.3 SEEDING ARGENTINE BAHIA LAWNS

- A. Sow seed with a spreader or seeding machine. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other. Do not use seed that is moldy or otherwise damaged in transit or storage. Seeding rate shall be as follows; Mix scarified bahia, bermuda, and brown top or rye at a rate of 8.6 pounds per 1,000 S.F. of area to be covered. Rake seed lightly into top 1/8" of soil, roll lightly, and water with a fine spray.

PART 4 – MAINTENANCE, CLEANUP AND PROTECTION

4.1 SEEDED AND SODDED LAWNS MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Maintain lawns for thirty (30) days, after Substantial Completion of entire project.
- C. Maintain lawns by watering, fertilizing, weeding, mowing, edging, and any other required operation. Roll, re-grade, and replant bare or eroded areas to produce a uniformly smooth lawn. Mow bahia lawns to a height of 2-1/2" whenever average height of grass becomes 4 inches. Mow as frequently as required to remove no more than 30 percent of the grass height in one mowing. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.

PART 5 - INSPECTION AND ACCEPTANCE

5.1 INSPECTION

- A. When Sodding work is completed, including maintenance, Landscape Architect will make an inspection to determine acceptability. Acceptable stand for sodded lawns is 95 percent ground cover of established species.
- B. Seeding Acceptance: It is the contractor's responsibility, before acceptance, to establish a dense, uniform lawn, free from lumps and depressions. Any part of the area that fails to show a uniform germination shall be re-seeded and watered if necessary, until a dense lawn is established. Damage to seeded areas resulting from erosion shall be repaired by the contractor. Seeded Areas will not be accepted as complete until the entire area has a vigorous cover of bahia sod.

END OF SECTION 32 4870

SECTION 32 6700 – LANDSCAPE AND IRRIGATION SYSTEM MAINTENANCE

PART 1 - GENERAL

- 1.01 PROVISIONS:
A. Requirements of the General Provisions apply to all work under this Section. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition.
- 1.02 DESCRIPTION:
A. Furnishing of and paying for all materials, labor, equipment, licenses, taxes and other items required for execution and completion of all work under this Section. The work described in this section of the specifications includes, but is not limited to, the following:

B. Maintenance of landscaping and irrigation system until and for one year following Substantial Completion.

C. The contractor shall be responsible to maintain the irrigation system, including electric valves, controllers, and sprinkler heads, and all necessary appurtenances.

D. Damage by others will not relieve the contractor of his responsibility to maintain the turf, shrubs, trees, ground covers and annuals in a healthy condition. The contractor shall immediately inform the owner's representative of any system failure, adjustments or repairs that are required.

E. The contractor shall provide supervision of the system and shall make all adjustments, repairs and replacements required. Contractor agrees to replace at his expense any part of the irrigation system damaged by his personnel during execution of this contract.
- 1.03 RELATED WORK:
A. The following items of related work are specified and included in other sections of these specifications:
Section 02810 – Underground Irrigation System
Section 02900 – Landscape Work
- 1.04 MAINTENANCE DATA:
A. Submit typewritten instructions recommending procedures to be followed by Owner for maintenance of the landscape and the irrigation system during one typical year.
- 1.05 MONTHLY MAINTENANCE WORKSHEET:
A. Contractor shall submit a Maintenance Worksheet to the owner's representative monthly, that records maintenance activities performed on the site, the date of services performed, and any problems encountered. Also record any chemical applications, showing dates when applications were made, type of chemical applied, where applied and rate of application. Any items not called to the attention of the Owner that result in damage to the property will fall under the liability of the Contractor.
- 1.06 LANDSCAPE WARRANTY:
A. Contractor must remove defective plants, including those that have died, have unsatisfactory growth, and have lost their original form, size and health not caused by vandalism and unseasonably severe weather; and to replace them with new plants within 10 days of discovery with new plants of same genus, species, variety and size of replaced defective plants. Warranty to replace defective plants with new plants for a one-year period, after substantial completion.
- 1.07 IRRIGATION SYSTEM WARRANTY:
A. Contractor shall warrant all irrigation parts replaced during maintenance work in full for material and labor for a period of one year after installation of such items.

PART 2 - PRODUCTS

- 2.01 Irrigation Replacement parts:
A. All parts replaced shall be identical to those that are being replaced. The owner's representative shall be informed in writing of any serious problems in the irrigation system. The contractor shall be responsible for operating the system in accordance with the manufacturer's specifications.

PART 3 - EXECUTION

3.01 FERTILIZATION:

- A. For shrubs and ground cover the fertilizer applications shall be as follows: March and October. Use a 10–10–10 formulation at a rate of two pounds per 100 S.F.
- A. For trees the fertilizer applications shall be as follows: March and October. Use a 13–6–10 formulation at a rate of two pounds per inch of caliper of less than 6" caliper and five pounds per inch of caliper over 6" caliper.
- B. For palms the fertilizer applications shall be as follows: March and October. Use a palm special 10-5-5 formulation at a rate of seven pounds per palm trunk.
- C. For lawns the fertilizer applications shall be as follows: March and October. Use a 15-5-10 formulation at a rate of 8.1 pounds per 1,000 S.F.
- D. Do not allow chemicals to fall on, or translocate on, off-site areas. Do not allow water containing toxic amounts of chemicals to pool or puddle after completion of operations.

3.02 MULCHING:

- A. All shrub and ground cover areas and natural areas are to be continuously maintained with clean, fresh mulch three-inch depth, match existing mulch type, reapplying as necessary for a fresh appearance.

3.03 WEED CONTROL:

- A. Control weeds in all mulch beds continuously throughout the term of this agreement to maintain the beds relatively weed-free. A combination of pre-emergent and post emergent herbicides shall be used in conjunction with mechanical methods to insure results. Apply herbicides in accordance with manufacturer's instructions. Control weeds in turf during the five required fertilization events mentioned above.

3.04 PEST AND DISEASE CONTROL:

- A. The Pest Control program shall be thoroughly controlled by a licensed pest control operator. The program shall be customized to the newly installed plant materials. Any adjustments that are required, such as additional fertilizer or insect control and disease control will be made at no additional charge. Instead of seeking to eradicate all insects the program shall be developed to control destructive insects while at the same time allowing those that are considered beneficial to the environment to survive. Apply pest and disease control chemicals in accordance with manufacturer's instructions. Spray or dust appropriate insecticide, miticide and fungicide as necessary to maintain plants in healthy and vigorous growing condition. Provide turf insect control three times a year as a minimum as follows; May, July and September, and more often if necessary.

3.05 TREE STAKING OR GUYING:

- A. Repair staking or guying for trees in accordance with related work. Remove staking and guying materials 6 months after Substantial Completion.

3.06 PRUNING:

- A. Prune or head back shrubs and ground cover plants in keeping with the nature and character of plants. Establish a uniform appearance and maintain maximum plant vigor based on approved horticultural practices. Shrub pruning shall occur a minimum of every three months, for a total of four pruning events in one year. Tree and palm pruning shall consist of removing dead or dying fronds and branches to maintain a clean, neat appearance.

3.07 SOIL EROSION:

- A. Replace fill in areas experiencing noticeable soil erosion and make minor repairs necessary to avoid further erosion. Notify Project Manager of unusual causes of erosion immediately.

3.08 MOWING AND EDGING:

- A. Lawn areas shall be maintained within the range of 2" – 4" high. Blades on mowers shall be kept sharp to facilitate efficient cutting of grass blades. Frequency shall be 4 times a month for the months of March thru November and twice a month for the months of December thru February for a total of 42 visits. Mowing shall be done so as not to remove more than 2" of grass blade at any single cutting. Grass clippings shall be removed if they accumulate into piles after mowing.

- B. Edging shall be accomplished at the same frequency as mowing and shall include walks and drives, curbs, bed perimeters and tree rings.
- 3.09 CLEAN UP:
A. Areas such as parking lots, curbs, walks and driveways will be kept clean of grass and the clippings resulting from maintenance. Trash such as paper, glass, cans and other litter shall be picked up and disposed of during each site visit.
- 3.10 IRRIGATION SYSTEM OPERATION:
A. Maintain irrigation system a minimum of twelve times a year as per these specifications. The contractor shall be knowledgeable and have experience with the operation of the system specified. The contractor shall have on-site record-drawings of the underground irrigation system.
- 3.11 WATER SCHEDULING:
A. The contractor shall be responsible for determining the water requirements of the turf, palms, trees, shade and ground covers.

B. The contractor shall program watering schedules into the controllers to meet site-specific turf and plant needs. Because turf water needs to vary from month to month, the amount of watering time shall be adjusted by the contractor periodically to reflect these needs. Use the water budgeting feature of the controller. A soil moisture probe meter shall be used by the contractor to determine soil moisture content in off-color turf areas and corrective action taken promptly to modify the watering schedule and rectify the condition.

C. Excessive watering shall be avoided. Plants shall be watered, therefore, by the contractor in accord with the season rainfall, soil type, turf type, topographical feature and evapo-transpiration factors.

D. All irrigation shall be between the hours of 9:00 p.m. and 6:00 a.m., unless otherwise approved in writing by the owner's representative.
- 3.12 IRRIGATION SYSTEM MAINTENANCE:
A. The contractor shall operate each valve in the system during every maintenance visit. Contractor shall check that all heads are working properly, nozzle spray patterns are correct, and that all areas are being evenly and completely irrigated.

B. All controllers, valves, and sprinkler heads that are not functioning in accordance with manufacturer specification and system design shall be immediately checked, repaired, and or replaced in accordance with owner's guarantee-warranty and manufacturer's specifications. The irrigation system shall be maintained to be fully functioning and operable in automatic mode at all times.
- 3.13 END OF MAINTENANCE PERIOD:
A. At end of maintenance period and when ground covers have established and landscaping and irrigation work is complete, request final landscaping inspection. When landscaping work is found to be satisfactory, maintenance period will end on date of final inspection. When work is found to be unsatisfactory, maintenance period will continue with no change in Contract Lump Price until work has been completed, inspected and approved.

SECTION 32 8100 – UNDERGROUND IRRIGATION SYSTEM

1.1 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. Piping.
 - 2. Automatic control valves.
 - 3. Dielectric fittings.
 - 4. Sprinklers.
 - 5. Controllers.
 - 6. Boxes for automatic control valves

1.3 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Retain first paragraph below unless drain valves discharge onto grade without downstream piping.
- C. ET Controllers: EvapoTranspiration Controllers. Irrigation controllers which use some method of weather based adjustment of irrigation. These adjusting methods include use of historical monthly averages of ET; broadcasting of ET measurements; or use of on-site sensors to track ET.
- D. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall have automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sprinklers, controllers and automatic control valves to include in operation and maintenance manuals.
- B. Record Drawings: Following completion and acceptance of installation, furnish "as-built" drawings showing all sprinkler heads, valves, controllers, and irrigation pipe locations to scale. Contractor shall provide a diagram or list of zones, including zone number, location and timing setting, inside each controller cover.

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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 GUARANTEE

- A. Guarantee: All equipment and installation shall be guaranteed against defects for a period of one year from the date of substantial completion. Any defects in materials or operation within that period shall be corrected immediately without expense to the Owner. Defects resulting from reasons other than neglect, undue weather conditions, or physical abuse shall be replaced as soon as it is reasonably possible after the unsatisfactory condition is brought to the attention of the Contractor.

PART 2 – PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. PVC Pipe: ASTM D1785, PVC 1120 compound, Schedule 40.
1. PVC Socket Fittings: ASTM D2466, Schedule 40.
 2. PVC Threaded Fittings: ASTM D2464, Schedule 80.
 3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.

2.2 PIPING JOINING MATERIALS

- A. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer according to ASTM F656.

2.3 AUTOMATIC CONTROL VALVES

- A. Plastic, Automatic Control Valves:
1. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

2.4 SPRINKLERS

- A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.
- B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:
1. Description:
 - a. Body Material: ABS.
 - b. Nozzle: ABS.
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
 2. Capacities and Characteristics:
 - a. Pop-up Height: 4 inches aboveground to nozzle.
 - b. Inlet: NPS 3/4.
- C. Plastic, Pop-up Spray Sprinklers:
1. Description:
 - a. Body Material: ABS.
 - b. Nozzle: ABS.
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
 - e. Pattern: Fixed, with flow adjustment.
 2. Capacities and Characteristics:
 - a. Pop-up Height: 4 inches aboveground to nozzle.
 - b. Inlet: NPS 1/2.
- D. Plastic Shrub Sprinklers:
1. Description:
 - a. Body Material: ABS or other plastic.
 - b. Pattern: Fixed, with flow adjustment.
 2. Capacities and Characteristics:
 - a. Inlet: NPS 1/2.
- E. Bubbler: Plastic with fixed pattern nozzle, with screw-type flow adjustment.

2.5 CONTROLLERS

- A. Description:
1. Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 120 minutes. Include switch for manual or automatic operation of each station.
 2. Interior Control Enclosures: NEMA 250, Type 12, dripproof, with locking cover and two matching keys.
 - a. Body Material: Molded plastic.
 - b. Mounting: Surface type for wall.
 3. Control Transformer: 24-V secondary, with primary fuse.
 4. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
 - a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
 - b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
 - c. Surge Protection: Metal-oxide-varistor type on each station and primary power.
 5. Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.
 6. Smart Controllers: Use ET, tested in accordance with IA SWAT Climatological Based Controllers 8th Draft Testing Protocol and compliant with ASHRAE Standard 189.1.
 7. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
 - a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
 - b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
 - c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

2.6 BOXES FOR AUTOMATIC CONTROL VALVES

- A. Plastic Boxes:
1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
 - a. Size: 12" x 21" x 15".
 - b. Shape: Rectangular.
 - c. Sidewall Material: HDPE.
 - d. Cover Material: HDPE.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."
- B. Provide minimum cover over top of underground piping according to the following:
1. Irrigation Main Piping: Minimum depth of 18 inches below finished grade.
 2. Circuit Piping: 12 inches.
 3. Sleeves: 18 inches.
- C. Construction Coordination: Location of existing and proposed underground utilities, structures and plantings shall be the responsibility of this Contractor. Any damages occurring due to irrigation installation shall be replaced or repaired to the satisfaction of the Project Manager at the expense of this Contractor.

3.2 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping free of sags and bends.
- C. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- D. Install fittings for changes in direction and branch connections.
- E. Install expansion loops in control-valve boxes for plastic piping.
- F. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- G. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.
- H. Install piping in sleeves under parking lots, roadways, and sidewalks.
- I. Install sleeves made of Schedule 40 PVC pipe and socket fittings, and solvent-cemented joints.
- K. Sleeves: Where existing or proposed paved surfaces cross irrigation lines, all piping under said surfaces shall be in sleeves. Install sleeves prior to the construction of new sidewalks and roadways. Where existing pavement must be cut to install irrigation pipe, saw cut smoothly to straight lines, six inches wider than the trench. Excavate to the required width and depth. Remove cutout material from the site. After installation of pipe and backfill, repair or replace pavement cuts with an equivalent material and finish to match existing.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join schedule number, ASTM D1785, PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.
 - 3. PVC Nonpressure Piping: Join according to ASTM D2855.

3.4 CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.5 VALVE INSTALLATION

- A. Control Valves: Install in underground piping in boxes for automatic control valves.
- B. Drainage Backfill: Valves within boxes shall be set in 3" deep clean gravel or crushed stone, graded from 3" maximum to 3/4" minimum.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Connect sprinklers to piping using Kaf-Flex, flexible IPS hose with fittings or approved equal.

- D. Locate sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.

3.7 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install interior controller on wall.
 - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Install control cable in same trench as irrigation piping and at least 2 inches below piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.8 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221113 "Facility Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- C. Connect wiring between controllers and automatic control valves.

3.9 IRRIGATION WATER SOURCE

- A. Irrigation water source is a new well. All permits shall be obtained by the pump/ well Contractor prior to installation. Refer to Plans for layout and specifications. Coordinate electrical connections as required.
- B. For the irrigation system the well contractor shall discuss the anticipated well depth and water quality with the Landscape Architect. The potential for well water high in iron content that results in staining must be prevented. Any adjustments to the well depth, increased pump horsepower, water filtration or treatment processes (including rust removal devices) may be required by the contractor to meet these requirements and must be addressed prior to ordering/ installation of any material.

3.10 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Leak Test: After installation, charge main line and valves and look for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Testing: After completion of grading, seeding, sodding, mulching and rolling of grass areas, carefully adjust lawn sprinkler heads so they will be flush with or not more than 1/2" above adjacent soil or mulch. Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinkler heads adjusted to final position. Demonstrate to Landscape Architect that system meets coverage requirements and that automatic controls function properly. Coverage requirements are based on operation of one circuit at a time. Contractor shall uncover pipe and valve connections as directed by the Landscape Architect, for the purposes of inspection.
 - 3. Test and adjust controls. Replace damaged and malfunctioning controls and equipment.

3.11 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

3.12 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

END OF SECTION 32 8100

SECTION 32 8500 - IRRIGATION WELL

PART 1 - GENERAL

1.1 SUMMARY OF WORK:

This section includes but is not limited to the following: Applications and permits for drilling and developing wells. Drilling for final water well depths. Placing and grouting well casings. Development of ten wells, installing pumps and testing.

Related Sections: The following sections contain requirements that relate to this section: Section "Underground Irrigation System" for irrigation installation. Section "Landscape Work" for landscape installation.

1.2 SYSTEM PERFORMANCE REQUIREMENTS:

Provide one well with producing capacity of 45 gallons per minute, with a minimum 50 PSI at the source. Equipment location and installation details for water well work are shown on the drawings.

Water well work is based on the following criteria: Drill well to depth needed to produce above specified requirements. Place 4" diameter casing for well with 3 HP pump. Minimum 2-inch thick grout, total depth casing. Well and casing depths shall be sufficient to guarantee that water will not stain walks, walls, and landscape material

1.3 QUALITY ASSURANCE:

Protecting Water Quality: Take precautions to prevent contaminated water or water having undesirable chemical characteristics from entering stratum from which well is to draw its supply. Prevent contaminated water, gasoline, etc. from entering well either through opening or by seepage through ground surface.

If well becomes contaminated or water having undesirable physical or chemical characteristics enters well due to neglect, provide casing, seals, sterilizing agents or other materials to eliminate contamination or shut off undesirable water. Provide remedial work at no cost to the owner.

Exercise care in performance of work to prevent breakdown or caving of strata overlaying that from which water is to be drawn. Develop, pump or bail well until water pumped from well is substantially free from sand. Protect work to prevent either tampering with well or the entrance of foreign matter. Upon completion, provide temporary well cap.

Drillers Requirements: Experienced foreman or driller to be constantly in control of well site and who has authority to take orders from the Owners Representative and upon request, furnish well drilling information desired by the Landscape Architect.

1.4 ABANDONMENT OF DRILLING:

If it becomes necessary to abandon drilling operation before completion of water producing well, follow regulations for abandonment of well as required by local authorities having jurisdiction.

Should abandonment of drilling be necessary due to poor workmanship or quality of water, or for such other reason that the Owners Representative deems to be no fault of the contractor; compensation for work will be based on unit price of contract.

1.5 SUBMITTALS:

General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

Casings - diameter, thickness, weight per foot length, and depth below grade.

Screen - Diameter, opening size.

Pumping Test - static water level, maximum safe yield, draw down at maximum yield.

Alignment - certification that well is aligned and plumb within specified tolerances.

Product Data shall include pressure rating, rated capacity, settings, and electrical data of selected models for the following: 3 HP Pump, Pressure Tank.

PART 2 - PRODUCTS

2.1 CASING AND GROUT:

Provide schedule 40 PVC solvent weld well casing. Cement shall be ANIS/ASTM C 150, type to suit project conditions.

2.2 PUMP ASSEMBLY:

3 HP Submersible Pump: Model 45GS50 submersible pump as manufactured by Goulds. M30434 pump end, and appropriate Control Box. Pump shall provide 45 GPM at a pressure of 50 PSI, with 208 volt, three phase, 60 cycle power.

Pressure Tank: Install Well-X-Trol WX-250, pressure tank, at pump location. Install as per manufacturer's recommendations and the Pump Station Details on the plans.

Pump Wiring: General contractor is responsible to provide 480V wiring to the pump location. Contractor shall provide a control transformer that will provide adequate amperage for the pump control panel as well as an additional 2.5 amps to operate an irrigation controller. Contractor shall also provide a WPGF receptacle for maintenance purposes. For all pumps: irrigation contractor shall provide connections between pump, starter, pressure tank, pressure switch, and controller.

Concrete Pad: Provide one concrete pad approximately 5' x 4' x 4" for each pump assembly, and heavy-duty fasteners for all equipment.

Fencing: See Well detail for fencing dimensions. A 3" deep layer of gravel from 1 1/2" to 3/4" in size shall be installed inside fenced pump assembly enclosure, in area that is not covered by concrete slab.

PART 3 - EXECUTION

3.1 INSTALLING GROUT:

Mix grout with proportions of one cubic foot of cement (94 lb. sack) with 5 to 6 gallons of water. Bentonite clay may be added, in amounts of 3 to 5 pounds per cubic foot of cement. If bentonite clay is added, water may be increased to 6.5 gallons per cubic foot of cement.

Place grout continuously to insure entire filling to annular space in one operation. No drilling operation or other work in well will be permitted within 24 hours after grouting of casing. If quick-setting cement is used this period may be reduced to 12 hours.

Provide permanent casing with a temporary well cap. Top of casing shall be 36" above existing grade, unless otherwise indicated.

3.2 DEVELOPMENT:

Develop wells by such methods as will effectively extract from water-bearing formation maximum practical quantity of sand, drilling mud and other fine particles in order to bring well to a maximum yield per foot of draw-down and to a sand-free condition. Perform work in a manner that does not cause settlement and disturbance of strata above water bearing formation nor disturb seal affected around well casing, reducing sanitary protection otherwise afforded by such seal.

Continue development of wells until water pumped from well at maximum testing pumping rate is clear and free from sand. Water shall be considered sand-free when no samples, taken during test pumping, contain more than two parts per million of sand by weight.

Plumbness and Alignment: Set casings and liners around, plumb, and true to line, within 1/2" tolerance.

PART 4 - TESTING

4.1 TESTING FOR YIELD AND DRAWDOWN:

After wells have been constructed and cleaned out and the depth of the wells accurately measured, conduct final pumping test. Provide a variable capacity test pump with minimum capacity of maximum expected yield at a total head equal to draw down in well, plus head loss in pump column and discharge pipe.

Provide labor, motive power, and other necessary materials, equipment and supplies required to operate pumping unit. Final testing shall consist of eight hours of continuous pumping after maximum draw down has been reached. After completion of final test, remove by bailing sand pumping or other methods, sand, stones or other foreign materials that may become deposited in well.

After test pump and auxiliary equipment have been installed, make arrangements for conduction pumping test and notify Owners Representative three days prior to starting test. Note water levels elevations referred to an assigned datum in well, time pump started and adjusted to required pumping rate. Record readings of water level in well and pumping rate at 30- minute intervals. When draw down in well is five feet above top of suction screen after designated time, record maximum yield to well. Upon completion of pumping test, record returning water levels in well for a sufficient period, at time intervals so that a curve of recovery rate of well may be plotted.

4.2 MEASUREMENT AND PAYMENT

Bases of Bid: Contractor shall provide a base bid total cost for a well depth of 250 feet deep and a casing depth of between 150 – 170 feet. A unit price per lineal foot shall be provided to add or delete to the base bid cost. Payment shall be based on the actual depth of well.

END OF SECTION 32 8500

SECTION 32 9000 – LANDSCAPE WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes provisions for the following items: Trees, Shrubs, Ground Cover, Finish Grading, Lawns, Soil Amendments and Initial Maintenance of landscape materials.

1.3 QUALITY ASSURANCE

- A. Do not make substitutions. If specified landscape material is not obtainable, submit proof to the Landscape Architect, together with proposal for use of equivalent material.
- B. Analysis and Standards: Package products with manufacturers certified analysis. For other materials, provide analysis by recognized laboratory made with methods established by the Association of Official Agriculture Chemists, wherever applicable.
- C. Trees, Shrubs and Ground Cover: Provide trees, shrubs, and ground cover of quantity, size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of Florida #1 standards as given in, Grades and Standards for Nursery Plants, latest edition, published by the Florida Department of Agriculture and Consumer Services. Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae, and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.
- D. The Landscape Architect may inspect plant materials either at place of growth or at site before planting for compliance with requirements of specifications. Landscape Architect retains right to further inspect plant materials for size and condition of root systems, insects, and injuries, and to reject unsatisfactory material at any time during progress of work. Remove rejected materials immediately from project site.
- E. Pre-Installation Conference: Contractor must attend conference at Project site with Landscape Architect and Owners Representative to discuss planting procedures, scheduling, and requirements for approval.
- F. All existing trees within the limits of the work shall be pruned by a licensed professional in a manner that minimizes disturbance of areas not under construction. Wood and debris shall become the property of the contractor and shall be removed from the site. Contractor shall protect root areas and crowns of trees not designated for work under this contract from damage from operations and equipment. Provide barricades as per the details on the plan.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Contractual Conditions and Division one Specification Sections.
- B. Manufacturer's certified analysis for fertilizer materials, mulch type, washed shell, aluminum edging, aluminum stakes and geotextile fabric.
- C. Maintenance Instructions: Typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one full year.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration while stored at site.
- B. Trees, Shrubs and Ground Cover: Provide Container Grown trees, shrubs and ground cover. Do not prune prior to delivery. Do not bend or bind trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery.
- C. Deliver plant materials after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set plant stock in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.

- D. Do not remove container-grown stock from containers until planting time.
- 1.6 JOB CONDITIONS
- A. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Contractor will be responsible for any damages occurring due to failure to locate underground utilities. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
 - B. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Landscape Architect and Owner's Representative before planting.
 - C. Installer must examine Sub-grade, verify elevations, and observe conditions under which work is to be performed, and notify Landscape Architect of unsatisfactory conditions. The installer shall not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
- 1.7 SEQUENCING AND SCHEDULING
- A. Planting Time: Proceed with, and complete landscape work as rapidly as portions of site become available. Plant shrubs, ground cover and sod after installation of underground irrigation.
 - B. Coordination with lawns: Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to the Landscape Architect.
- 1.8 SPECIAL PROJECT WARRANTY
- A. Warranty trees, shrubs and ground cover, for a period of one year after date of substantial completion, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Installer's control.
 - B. Remove and replace trees, shrubs, or ground cover found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace trees and shrubs, which are in doubtful condition at end of warranty period.
 - C. Another warranty inspection will be conducted at end of extended warranty period, if any, to determine acceptance or rejection. Only one replacement (per tree, shrub or plant) will be required at end of warranty period, except for losses or replacements due to failure to comply with specified requirements.

PART 2 – PRODUCTS

- 2.1 SOIL AMENDMENTS
- A. Mulch: Organic mulch free from deleterious materials and consisting of the following: Pine Bark Nugget mulch, Grade "A" or approved equal.
 - B. For all ground cover, shrubs, trees, and palms provide Osmocote Plus 15-9-12 slow release formulation to the soil surface of each plant pit at the manufacturer's recommended rate.
- 2.2 PLANT MATERIALS
- A. Quality: Provide trees, shrubs, and other plants of size, genus, species, and variety shown and scheduled for Landscape work and complying with recommendations and requirements of Florida Number One standards for type and species required.
 - B. Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by Florida #1 Standard for type and species required. Provide single stem trees except where special forms are listed.
 - C. Shrubs and Ground Cover: Provide shrubs and ground cover of the height listed and with not less than minimum number of runners required by Florida #1 for type and height of plant material required.
 - D. Container Grown Plants: All container grown plants shall be well rooted and established in the container in which they are delivered to the site and shall have been in that container long enough for the fibrous roots to hold the soil together when the plant is removed from the container. Plant shall not be root-bound in the container. Container grown plants shall not be removed from the container until immediately before planting and with all due care to prevent damage to the root system.

2.3 MISCELLANEOUS LANDSCAPE MATERIALS

- A. Pre-emergent Herbicide: "Ronstar" pre-emergent herbicide or approved equal.
- B. Stakes and Guys: Rough-sawn, sound wood, 2-by-2 inch nominal by length indicated, pointed at one end or lodge poles. Flexible ties: Wide rubber or elastic bands or straps of length required to secure stakes to trees.

PART 3 – EXECUTION

3.1 PREPARATION GENERAL

- A. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Landscape Architect's acceptance before start of planting work. Make minor adjustments as may be required.

3.2 TREE PRUNING

- A. Before construction starts, all existing trees within the limits of work shall be pruned as follows: Prune trees to minimum 12' clear trunk or as specified on plans. Remove any diseased trunks or branches and remove weak or crossed branches. All roots to be removed during the site-clearing phase shall be severed clean at the perimeter of the designated protected radius.
- B. Cutting back or drop crotch pruning shall consist of the reduction of tops, sides, under branches or individual limbs. All cuts shall be made sufficiently close to the trunk or parent limb, without cutting into the branch collar or leaving a protruding stub, so that closure can readily start under normal conditions. It is necessary to pre-cut branches too heavy to handle to prevent splitting or peeling the bark. Attention shall be taken to the symmetrical appearance of the canopy.
- C. Use clean, sharp tools, disinfect where necessary to prevent the spread of disease. Limbs and debris from this work shall be transported and not dragged over the site.

3.3 PREPARATION OF PLANTING SOIL

- A. Before mixing, clean existing soil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
- B. Aerate existing soil before backfilling. Backfill as specified below.

3.4 EXCAVATION FOR TREES, SHRUBS AND GROUND COVER

- A. For all landscape materials (trees, shrubs and ground cover), make excavations at least twice as wide as the ball diameter and 1" - 2" less than the ball depth. Fill excavations for trees, shrubs, and ground cover with water and allow water to percolate out prior to planting.

3.5 PLANTING TREES, SHRUBS AND GROUND COVER

- A. Set stock on undisturbed existing soil, plumb and in center of pit with top of ball 1" - 2" above the elevation of adjacent finished grades. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill. Repeat watering until no more is absorbed. Add Osmocote fertilizer to the surface of each plant pit before mulching.
- B. Mulch pits, trenches, and planted areas. Provide not less than three-inch thickness of mulch, and work into top of backfill and finish level with adjacent finish grades. Keep mulch minimum 4" away from tree trunks.
- C. Prune new trees and shrubs in accordance with standard horticultural practice, only if needed. Retain required height and spread. Do not cut tree leaders and remove only injured or dead branches.

3.6 MISCELLANEOUS LANDSCAPE WORK

- A. Pre-Emergent Herbicide: Apply "Ronstar" or approved equal to all mulch areas according to the manufacturer's recommended rate. Contractor shall be responsible to re-apply appropriate herbicide to eradicate all remaining weeds and maintain a weed free condition in all areas throughout all landscape operations.
- B. Staking: Stake trees and palms immediately after planting, as indicated in the details.

3.7 MAINTENANCE

- A. Begin maintenance immediately after planting.
 - B. Maintain palms, trees, shrubs, and ground cover until final acceptance, but in no case, less than the following period: 30 days after substantial completion of planting.
 - C. Maintain trees, shrubs, and ground cover by pruning, and weeding as required for healthy growth. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Spray as required to keep plants free of insects and disease.
- 3.8 CLEANUP AND PROTECTION
- A. During landscape work, keep pavements clean and work area in an orderly condition.
 - B. Protect landscape work and materials from damage due to operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.
- 3.9 INSPECTION AND ACCEPTANCE
- A. When landscape work is completed, including maintenance, Landscape Architect will, upon request, make an inspection to determine acceptability.
 - B. When landscape work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by Landscape Architect and found to be acceptable. Remove rejected plants and materials promptly from project site.

END OF SECTION 32 9000

SECTION 33 1000 - WATERMAIN

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Scope

This Section includes all water main Work complete with water main piping, valves, hydrants, thrust blocks, joint restraint, valve wells, structures, fittings, joints, joint materials, nuts, bolts, glands, gaskets, plugs and accessories as shown and required. This Section also includes bedding and laying of water main piping, hydrostatic testing of new water main piping systems, and flushing and chlorination of water main piping systems.

- B. Related Work Specified Elsewhere

- 1. Dewatering: Section 31 2319
- 2. Trenching, Backfilling and Compacting: Section 31 2333

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies

- 1. Cleaning and Disinfection

Conform to the applicable requirements of state and local health authorities having jurisdiction for disinfection and testing.

- B. Reference Standards

Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:

ANSI - American National Standards Institute

ASTM - American Society for Testing and Materials

AWWA - American Water Works Association

NSF - National Sanitation Foundation

Hillsborough County Technical Specifications

1.4 SUBMITTALS

- A. Schedules

- 1. Tabulated Laying Schedule

Where concrete water main pipe is used in the water main Work, a Tabulated Laying Schedule, showing stationing, deflection, elevation, slope and description of pieces shall be submitted to the ENGINEER OF RECORD AND THE OWNER. Pipe manufacture shall not be started until the laying schedule has been reviewed and approved by the ENGINEER OF RECORD.

2. Corporation Stops (Tapping Outlets)

A complete schedule of all tapping outlets installed in concrete water main piping shall be kept by the CONTRACTOR and submitted to the ENGINEER OF RECORD at the end of each water main piping section of the Project or on the last day of each week, whichever occurs first.

3. Manufacturer's Data

Provide product data "cut sheets" for materials and products being used on the project. Materials and products shall meet or exceed Hillsborough County requirements.

B. Affidavits

1. Butterfly Valves

Submit manufacturer affidavit showing compliance with AWWA C504, where applicable.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials

1. Concrete Pipe

Provide two (2) percent of pipe lengths to be delivered as short pieces with a length ten (10) feet or less. These short pieces shall be in addition to those required under the Tabulated Laying Schedule.

B. Storage of Materials

1. Water Main Piping

Pipe shall be stored in a manner to minimize infiltration of dirt, debris and other extraneous materials.

Piping materials shall not be stacked higher than four (4) feet. Suitable racks, chairs and other supports shall be provided to protect preformed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.

2. Hydrants, Valves and Accessories

Store all hydrants, valves, wells and prefabricated structures off the ground, drained and kept free of water to protect against damage. Hydrants, valves, wells, their accessories and appurtenances shall be kept in their original containers until ready for installation.

3. Gasket, Glands, and Seals

All joint and sealing materials subject to ultra-violet or ozone attack and used in the water main system shall be protected from the sunlight, atmosphere and weather, stored in suitable enclosures until ready for installation.

C. Handling of Materials

1. Loading and Unloading

Load and unload piping using suitably approved hoists and skidding. Piping shall not be dropped, bumped or allowed to impact against itself. Damaged piping shall be rejected by the ENGINEER OF RECORD.

2. Lifting Devices

Lifting devices shall be suited to the Work and shall protect surfaces from damage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Scope

It is the intent of this Article to specify in detail the various types of pipe, joints, and fittings which have been indicated throughout the Plans and Specifications. This Article shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications. All materials specified shall be in conformance with the Hillsborough County Technical Specifications for Water Mains.

B. Ductile Iron Piping Systems

1. Ductile Iron Pipe

Pipe shall be AWWA C151 / ANSI A21.51, with double thickness cement mortar lining and 1-mil thickness minimum of coal tar enamel inside and outside. Pipe shall have the minimum wall thickness and nominal inside diameter for the pipe class indicated on the Plan. All ductile iron pipe shall be Class 52 unless noted otherwise.

2. Joints

Mechanical, compression gasket type, conforming to AWWA C111/ANSI A21.11 except that slots with the same width as the diameter of the bolt holes in mechanical joints shall not be allowed in the bell flange.

Push-on, compression gasket type conforming to AWWA C111/ANSI A21.11 with spigot of pipe marked to visually determine when the spigot is fully seated in the bell of the adjoining section.

Flanged, conforming to AWWA C115/ANSI B16.1 shall be DIP.

3. Fittings

Ductile iron, pressure rating of 250 psi conforming to AWWA C110/ANSI A21.10 and AWWA C111 /ANSI A21.11, with double thickness cement mortar lining and coal tar enamel coating on the inside and outside of fittings. All fittings shall have AWWA C110/ANSI A21.10 laying lengths equivalent to those listed for mechanical joint fittings.

Flanged joints shall meet the requirements of ANSI B16.1. Bolts and nuts shall meet the requirements of ASTM A 307, Grade B. Gaskets shall be rubber with cloth insertions and shall be full face meeting the requirements of ANSI 16.21.

4. Sleeve-type couplings shall be as specified in the Hillsborough County Technical Specifications for Water Mains.

5. Nuts and Bolts

High strength low alloy steel conforming to AWWA C111/ANSI A21.11.

C. Flexible Joint Piping Systems

1. Pipe

Ductile iron conforming to AWWA C151 / ANSI A21.51, with double thickness cement mortar lining and 1-mil minimum outside coating of coal tar enamel. Pipe shall have the minimum wall thickness and nominal inside diameter for the pipe class indicated on the Plans.

2. Joints

Flexible, ball and retainer type boltless joint.

D. Cement Mortar Pipe Linings

Cement mortar linings for cast iron and ductile iron pipe shall conform to the requirements of AWWA C104 /ANSI A21.4 of the thicknesses specified and shall be permanently set prior to the application of any additional pipe coating.

E. Coal Tar Enamel Coatings

1. Primers
AWWA C203, Type A.
2. Coal Tar Enamel
AWWA C203, Type I.

Pipe coatings shall be shop applied. Prime all surfaces. Coal tar enamel coatings shall be hot applied. Coatings shall be applied uniformly over all surfaces and when set, shall be firm, tenacious and tough; shall not sag at 140 degrees F and shall not check or peel at 20 degrees F. Coatings after drying for 48 hours, shall have no deleterious effect upon the quality, color, taste or odor of potable water.

F. Bituminous Paint

Two (2) coats of cold-applied bituminous paint may be applied to the exterior surfaces of ductile iron pipes and fittings in lieu of hot applied coal tar enamel provided all the other requirements of paragraph 2.01.E. of this Section are met. Bituminous paint shall be prepared from coal tar enamel and suitable solvents conforming to AWWA C203, Type I.

G. Polyvinyl Chloride (PVC) Piping Systems

1. Pipe and Couplings

Rigid polyvinyl chloride bell and spigot type pressure pipe and couplings conforming to AWWA C900, for four (4) inches and larger pipe or ASTM D2241 for pipe smaller than four (4) inches, of the types and pressure class indicated on the Plans. Compounds used for production of PVC pipe and components shall be suitable for potable water products as required in Sections 3 and 4 of NSF Standard 14. Spigot end of pipe shall be marked to visually determine when the spigot is fully seated in the bell of the adjoining pipe.

2. Joints

Push-on or mechanical elastomeric gasket type, conforming to ASTM D3139.

3. Fittings

a. Polyvinyl Chloride

Two hundred (200) pound Pressure Class conforming to AWWA C900 of types and sizes indicated on the Plans.

b. Gaskets

Elastomeric seal type conforming to ASTM F477.

c. Lubricants

Manufacturer's standard non-toxic conforming to AWWA C900.

H. Valves and Hydrants

1. Bronze Bodied Gate Valves

Values shall be composed of brass conforming to ASTM B62 (85-5-5) and to federal specification WW-V-541, Class A, Type I, wedge disc, nonrising stem gate.

2. Resilient - Seated Line Valves

Valves shall conform to AWWA Standard C 509 with nonrising stems.

3. Fire Hydrants

Dry barrel breakaway compression type with counter clockwise opening fire hydrants conforming to AWWA C502-85 with approved U.L. Listed (AWWA, U.L., and F.M. colophons must be cast in upper barrel of each hydrant.

4. Tapping Sleeves

Mechanical joint sleeves shall be furnished complete with valve, stops, caps, plugs and joint accessories as indicated on the Plan. The sleeve shall be of a 2-section type.

I. Valve Boxes

Gray iron castings conforming to ASTM A48, Class 20. Overall length shall be adjustable to meet grade.

J. Corporation Stops

Corporation stops, couplings and plugs shall be water service bronze of type and size detailed on the Plans.

K. Service Clamps

The clamps shall be compatible with the main and service lead, with straps of a ductile material to avoid crushing the main out-of-round. A molded gasket of rubber or neoprene shall completely encircle the tapped opening to insure a watertight connection. The use of lead gaskets is not allowed.

L. Curb Stops

Water service bronze of types and sizes detailed on the Plans.

M. Threaded Fittings

Where indicated on the Plans, threads for water main service fittings shall conform to the requirements of AWWA C800 and AWWA C800 Appendix for Materials.

N. Water Service Pipe

1. Soft Copper

Type K conforming to ASTM B-88, with flared fittings.

2. Polyvinyl Chloride

Conforming to ASTM D2241 or D1785 Schedule 40.

O. Restraints, Clamps, Rods, and Ties

1. Cast iron or steel as recommended by pipe manufacturer. Balls and fittings shall be bronze alloy or corrosion protected steel.

Restraints for mechanical joint pipe and fittings and push on joint pipe and fittings shall be in accordance with the Hillsborough County Technical Specifications for Water Mains.

P. Structures

Material for water main structures shall conform to the requirements listed below:

1. Clay Brick

Grade MS of ASTM C32 recessed and/or cored as approved.

2. Concrete Block

ASTM C139, Type II, shape and scored as detailed and as approved.

3. Precast Concrete Units

ASTM C478, circular with circular reinforcement as detailed. Provide lifting holes in precast units where indicated.

4. Covers and Frames

Provide types and sizes as detailed on the Plans. Covers shall be Class 30, ASTM A48 gray iron castings. The castings shall be neatly made and free from cracks, cold sheets, holes and other defects. Surfaces of castings shall be ground to assure proper fit and to prevent rocking. Units shall be frostproof and shall be provided with tapping screws and anchors where indicated on the Plans.

Q. Bolts, Studs, and Nuts

Bolts, studs, and nuts shall be as specified on the Plans and shall conform to the requirements of AWWA C500 and the ASTM standards listed below:

Bronze ASTM B98

Steel ASTM A307, Grade B

Cadmium Plating ASTM A165, Grade N.S.

Zinc Coating ASTM A153 or A164, Type G.S.

Tee head bolts and nuts shall be high strength, low alloy steel conforming to ANSI/AWWA C111/A21.11.

R. Granular Material

Granular material shall be in accordance with the Hillsborough County Technical Specifications and meeting the approval of the ENGINEER OF RECORD

2.2 ACCEPTABLE MANUFACTURERS
(CONTRACTOR TO VERIFY CURRENT COUNTY APPROVED LIST)

A. Flexible Joint

Acceptable manufacturers include: F141, Clow, Usiflex, U.S. Pipe, or equal.

B. Bronze Bodied Gate Valves

Acceptable manufacturers include: Hammond IB645, American 3FG, NIBBCO T-113, Grinne 3000.

C. Resilient Seated Line Valves

Acceptable manufacturers include: Clow 6100, 6103, and 6110, Kennedy Kenseal - II, American AFC-500, U.S. Pipe Metroseal 5460, M&H - 3067.

D. Fire Hydrants

Acceptable manufacturers include: Clow Medallion, U.S. Pipe Metropolitan-250, American B-84-B, Mueller A-426.

E. Valve Boxes

Acceptable manufacturers include: F2450, Clow, Series 6860, Tyler, or equal.

F. Corporation Stops

Acceptable manufacturers include: Hays; Crane; Mueller; Ford; or equal.

G. Service Clamps

Acceptable manufacturers include: Twin Seal, Clow, Service Clamps, Mueller, or equal.

H. Curb Stops

Acceptable manufacturers include: Ford, Mueller, or equal.

I. Sleeve-type couplings

Acceptable manufacturers include: Dresser Industries Inc. style 38, Smith-Blair type 411.

J. Restrained Mechanical Joint

Acceptable manufacturers include: American Cast Iron Pipe Company, Clow F-1058

K. Restrained Joint Pipe

Acceptable manufacturers include: Clow F-128 "Super Lock Joint", American Cast Iron Pipe "Lok-Fast Joint", and US Pipe and Foundry "TR Flex."

PART 3 - EXECUTIONS

3.1 CONTRACTOR'S VERIFICATION

A. Excavation and Bedding

Prior to the installation of any water main piping or materials, examine all trenches and other excavations for the proper grades, lines, levels and clearances required to receive the new Work. As certain that all excavation bottoms, compacted subgrades and pipe bedding are adequate to receive water main materials to be installed. Correct all defects and deficiencies before proceeding with the work.

B. Existing Water Mains

Expose the existing water main piping and structures to which the new Work is to be connected and notify the ENGINEER OF RECORD AND THE OWNER of the same. The ENGINEER OF RECORD will verify the vertical and horizontal locations of the existing system and shall inform the CONTRACTOR as to the necessary adjustments required to align the new water main work with the existing system.

3.2 PREPARATION

A. Pipe Ends

Remove all lumps, blisters excess coatings from the socket and plain ends of pipe. Wire brush and wipe clean the outside surfaces of all plain ends and the inside surfaces of all socket ends before installation. Any pipe or fitting which has acquired a coating of mud or other adhesive foreign material shall be scrubbed clean with heavily chlorinated water.

B. Examination of Materials

All pipe fittings, valves, hydrants, accessories and appurtenances shall be examined carefully for

damage and other defects immediately before installation. Defective or damaged materials shall be marked and held for inspection by the ENGINEER OF RECORD. Damaged materials are subject to rejection by the ENGINEER OF RECORD AND/OR OWNER. Damaged materials shall be replaced by the CONTRACTOR at the CONTRACTOR'S expense.

3.3 INSTALLATION

A. General

1. Pipe Cleanliness

Foreign matter shall be prevented from entering the pipe while it is being placed in the trench. During and after laying operations, no debris, clothing or other materials shall be placed in the pipe.

2. Pipe Plugs

During the progress of all water main work, watertight plugs shall be carried along and inserted in the end of each pipe as it is laid to prevent foreign matter or rodents from entering the pipe. This watertight plug shall be fastened in the end of the water main in such a manner as to prevent it from floating or being otherwise displaced whenever construction operations are temporarily halted, such as at noon or at the end of the days Work.

3. Pipe Bearing

Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length between bell holes.

4. Pipe Cutting

Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square cut end without damage to the pipe and that minimize airborne particles shall be employed. Pipe cutting shall be performed using the recommendations of the manufacturer of the type of pipe materials being cut and according to the best trade practices.

a. Pipe Linings and Coatings

When cutting pipe or fittings, care shall be taken to prevent damage to linings and coatings. Damage to linings shall be cause for rejection of the complete Section. Damage to exterior coatings shall be corrected to original Specifications.

b. Gaskets

Where pipe using a resilient gasket to effect the seal is cut, the cut pipe end shall be tapered at a 30-degree angle with the centerline of the pipe, and ground smooth, on the outside end to remove any sharp edges or burrs which might damage the gasket.

5. Pipe Laying

Unless otherwise specified, pipe shall be laid with bell ends facing in the direction of laying. After a length of pipe is placed in the trench, the spigot shall be centered in the bell end of the adjacent pipe section, the pipe shoved into position and brought to true alignment and secured with sand tamped under and on both sides of the pipe except at bell holes. Adequate support shall be provided for all water main pipe.

6. Pipe Bedding

After the bottom of trench has been excavated and filled to the required grade with four (4) inches of select sand backfill approved by the ENGINEER OF RECORD, meeting the requirements of granular material (Hillsborough County Technical Specifications for Water

Mains) thoroughly compacted by tamping, the pipe shall be installed strictly in accordance with the manufacturers recommendations. After the pipe is laid, the sand backfill shall be continued to a point 12 inches above the top of pipe barrel.

Particular care shall be taken to assure filling and tamping all spaces under, around and above the top of the pipe. Backfill shall be as indicated on the Plans and in the Specifications. Continuous and uniform bedding shall be provided in the trench for all buried pipe.

7. Bolts, Studs, and Nuts

Install bolts, studs, and nuts of the type specified per the manufacturer's installation and torquing requirements. All steel bolts, studs, and nuts shall be painted with bituminous paint after installation.

8. Polyethylene Encasement

Polyethylene Encasement conforming to AWWA C105 shall be installed on all pipe and fittings within the sections shown on the plans or as directed by the ENGINEER OF RECORD and in accordance with the Hillsborough County Technical Specifications for Water Mains.

9. Restrained Joints

Provide restrained joints as shown on the plans. Connection shall be made in accordance with manufacturer's recommendations.

10. Water Main Marking

Ductile iron pipe shall be spiral wrapped with 2" blue vinyl tape as per Hillsborough County Technical Specifications for Water Mains. Polyvinyl Chloride Pipe shall be marked with 3" detectable tape installed 12" over top of the pipe.

B. Ductile Iron Pipe

1. Push-On Joints

Joints shall be made by means of a compression type push-on resilient gasket. Gasket shall be pre-lubricated before installation using a lubricant recommended by the pipe manufacturer. The seated joint shall be identified by the visible mark on the spigot of the installed pipe section.

2. Mechanical Joints

Joints shall be made with bolts, molded resilient gasket and ductile iron follower gland. All nuts shall be screwed up finger tight before using a wrench. The gland and rubber gasket shall be brought up evenly at all points around the bell flange and then torqued per the manufacturers recommendations. The normal range of bolt torques to be applied to standard cast iron bolts in a joint and the lengths of wrenches that should satisfactorily produce the ranges of torques are as follows:

Pipe Size	Bolt Size	Range of Torque	Length of Wrench
3 inch	5/8 inches	45-60 ft. lb.	8 inches
4-24 inch	3/4 inches	75-90 ft. lb.	10 inches
30-36 inch	1 inch	100-120 ft. lb.	12 inches
42-48 inch	1-1/4 inches	120-150 ft. lb.	14 inches

Exposed portions of bolts shall be covered with mastic.

3. Flexible Joint Pipe

Flexible joint pipe shall be assembled, handled and installed in accordance with the printed

recommendations, which accompanies the pipe and is provided by the manufacturer of the piping materials being installed. Methods of handling and installation shall be acceptable to the ENGINEER OF RECORD

C. Polyvinyl Chloride Pipe

Polyvinyl chloride pipe shall be laid with gasketed joints in complete accordance with the pipe manufacturers published instructions. The joints shall be sufficiently lubricated using the pipe manufacturers recommended lubricant.

Gaskets for pipe joints shall be inserted with the painted edge facing the end of the bell. Each length of pipe shall be pushed home individually. The pipe shall be positioned so that the reference mark on the spigot end is in line with the bell end.

D. Valves, Hydrants, Fittings, and Appurtenances

1. Valves

All valves shall be installed to the grade, lines, levels and locations indicated on the Plans.

Valve connections shall be as specified for the piping materials used. Valves shall be set with the stem plumb on permanent, firm foundations as indicated on the Plans.

Where required, valves shall be supported with special supports as indicated on the Plans and as approved by the ENGINEER OF RECORD. Valves shall be installed so as not to receive support from the connecting pipe. In no case shall valve installation be used to bring misaligned pipe into alignment.

2. Hydrants

All hydrants shall be installed plumb to the lines, levels, grades and locations indicated on the Plans. Hydrants shall be set to the established grade, shall have their nozzles parallel to or at right angles to and facing the grade or curb.

Where necessary to adjust for proper hydrant grade and location, the CONTRACTOR shall install additional fitting and spigot pipe between the water main and road box.

The CONTRACTOR shall plumb all hydrants at the time they are set with a plumb line or other means acceptable to the ENGINEER OF RECORD. Upon substantial completion of cleanup, the CONTRACTOR shall recheck all hydrants for plumb and grade and shall make all adjustments as directed by the ENGINEER OF RECORD at this time. The Work of constructing fire hydrants shall not be considered complete until these final adjustments for plumb and grade have been made. No extra compensation will be paid to set hydrants plumb and to grade.

3. Relocation of Hydrants

Relocation of hydrants shall include the provision of new hydrant shoes and restraints. Provide all new materials required for hydrant relocation. Reinstall hydrants at the new locations to the lines and levels shown. Make all joint connections to new or existing water mains, joints, couplings, etc. as shown and as required. Provide all anchorage and restraint for a complete installation.

4. Valve Boxes

Install valve boxes to the grade, lines, levels and locations indicated on the Plans. Valve boxes shall not transmit shock or stress to the valve and shall be set plumb with covers centered over operating nuts and flush with the indicated surface elevations. Valve boxes that shift or fill during backfilling shall be uncovered and reset.

5. Corporation Stops

Corporation stops shall be located on water main piping where indicated on the Plans or as directed by the ENGINEER OF RECORD.

Install a minimum of two (2) corporation stops in each valve well.

One (1) inch tapping outlets shall be installed at approximately 20-foot intervals along the entire length of the concrete water main. These tapping outlets shall be constructed as detailed on the plans and shall be positioned 45 degrees off vertical. The location of the tapping outlets shall be marked by means of No. 4 reinforcing rod. The rod shall be placed in a vertical position immediately adjacent to, but not touching, the water main and the top, six (6) inches below finished grade.

6. Service Clamps

Where service clamps are to be installed, the entire circumference of the main shall be free of all loose material. Installation of the clamp and tapping of the main shall be in accordance with manufacturers' recommendations.

7. Curb Stops

Install curb stops of the types and sizes indicated on the Plans.

8. Fittings, Strapping, and Lugged Pipe

a. Fittings

Install all fittings to the lines, levels and locations indicated on the Plans. Installation of fittings shall be with the type of joint specified for piping. Fittings shall be provided with restraints as specified herein as indicated on the Plans and as required for a functional installation.

b. Strapping, Lugged Pipe and Fittings

Where indicated on the Plans and as directed by the ENGINEER OF RECORD, bends in water main piping and piping runs subject to impact reaction shall be secured by means of metal strapping. Install all necessary bands, tie rods, nuts and washers required. No metal strapping shall be used in direct contact polyvinyl chloride pipe.

Where lugged pipe and special fittings are indicated on the Plans, furnish and install all necessary tie rods, nuts and washers.

9. Anchors and Thrust Blocks

Anchors, encasements and restraints shall be provided at the locations and dimensions as indicated on the Plans. Anchoring, encasement and restraint methods shall be as detailed. All bearings shall be as shown. Anchors, encasements and restraints shall rest on firm, stable, compacted subgrade and shall be provided for all standard and special fittings.

E. Water Main Structures

Construct water main valve wells and structures to the grades, lines and levels indicated on the Plans and as specified. Structures shall be complete with concrete bases, reinforcing, frames, covers, adjustment rings, etc., as shown and as required for a complete installation. Water main structures shall conform to the dimensions indicated on the Plans and as described below.

1. Brick

Prior to laying, all brick shall be thoroughly wetted and the surfaces allowed to dry only sufficiently to prevent slippage on the mortar.

Broken or chipped brick shall not be used on the faces of the structure.

Brick shall be laid in neat, even consecutive courses with full and close mortar joints. Courses shall be level throughout, except as shown or otherwise required. Stagger joints in adjoining courses by 1/2 a brick as nearly as practicable. At least one (1) course in every seven (7) shall be stretcher courses with intervening courses laid as headers. Length of brick closure pieces shall be not less than the width of one (1) whole brick and, wherever practicable, closures as headers shall be made from whole brick.

Unless otherwise indicated, joints shall be not more than 1/2 inch thick and shall be of a uniform thickness throughout the structure. Joints shall be provided as indicated on the Plans. Exposed surfaces shall be true and smooth. Rake all joints to receive plaster coat.

Prior to applying plaster coat, brick shall be thoroughly wetted with water and the surface allowed to dry sufficiently to effect proper bonding.

2. Concrete Block

Construct concrete block structures in the locations and according to the details on the Plans. The first course of concrete blocks shall be placed on the prepared base or footings in a full bed of mortar. Mortar joints shall be full and close in all courses. Courses shall be level throughout. Stagger joints in adjoining courses by 1/2 the length of the block as nearly as practicable.

Joints shall be uniform in thickness throughout the structures. Strike all joints and properly point to provide true, smooth surfaces.

3. Precast Concrete Units

Construct as detailed on the Plans. Provide mortar joints struck smooth. Provide two (2) to four (4) courses of 8-inch brick at top of structure for future adjustment.

4. Plaster Coat

Cement mortar plaster coat shall be applied to the exterior surfaces of all gate wells and other water main structures indicated on the Plans. Plaster coat shall be 1/2-inch thick and shall be applied to the outer surfaces of the structures.

5. Inlet and Outlet Pipe

Pipe placed in structures for inlet or outlet connections shall extend through the walls and beyond the outside wall surfaces a sufficient distance to allow for complete connections. Openings between pipes and walls shall be sealed with a full bed of cement mortar. Pipe shall be supported by concrete supports.

F. Air Release Assembly

Provide all materials and construct air release assemblies where indicated on the Plans. Install all valves, fittings, caps, plugs and piping as required. Fittings and joint materials used for air release assemblies shall be as specified herein for the water main piping materials used.

G. Blow-Off Assembly

Provide all materials and construct blow-off assemblies where indicated on the Plans. Blow-off assemblies and pipe shall be installed to the lines, levels and elevations shown, install all valves, fittings, reducers, piping, plugs, joints, etc. as detailed. Blow-off assemblies shall be installed on stable, undisturbed earth materials with changes in directions and returns provided with bedding and restraints as indicated on the Plans, as specified herein and as required for a complete installation. Blow-off assemblies shall include valve boxes as detailed.

H. Tapping Valve Assembly

Install all tapping valve assemblies of sizes and to the lines, elevations, locations and details indicated on the Plans. The tapping sleeve shall be assembled around the main, and the tapping performed in strict accordance with the manufacturers recommendations. Tapping shall be accomplished without

interruption of service.

I. Anchors, Encasements, and Restraints

Plugs, tees, sleeves, bends, caps, straps and lug piping shall be provided with suitable anchors, encasements and restraints as indicated on the Plans. Anchoring, encasement and restraint methods shall be as detailed. All bearings shall be as shown. Anchors, encasements and restraints shall rest on firm, stable, compacted subgrade and shall be provided for all standard and special fittings.

J. Water Service Lines

1. General

When so indicated in the Proposal(s), or on the Plans, the CONTRACTOR shall provide water service lines in accordance with Article 3.03.K.2. and 3.03.K.3. of this Section. Otherwise, water service lines are not required.

2. New Water Main

a. General

Water service lines shall be installed after the water main has been successfully tested and put into service, including the installation of fire hydrants. The service lines shall be of the type indicated on the Plans, and shall be 3/4 inch diameter unless otherwise indicated on the Plans.

Water service lines shall be provided for all lots or parcels at the locations indicated on the Plans, within these Contract Documents or as directed by the ENGINEER OF RECORD. Service lines shall extend from the water main to within 1-foot of the limits of a right-of-way or easement at minimum 5-foot depth terminating with a curb stop as specified herein. A water main test shall be conducted by the CONTRACTOR and witnessed by THE ENGINEER OF RECORD to confirm water pressures are maintained during game day event. Corrective work required shall be the CONTRACTOR'S expense and retesting will be required if specified criteria is not met.

b. Installation Method

Water service lines under concrete or asphalt pavements shall be installed by boring or tunneling (per Hillsborough County Standards), unless otherwise indicated on the Plans or directed by the ENGINEER OF RECORD

Backfilling of open cut construction shall be in accordance with Section 312333, Trenching, Backfilling, and Compacting, after the service line, including curb stop, has been laid and approved by the ENGINEER OF RECORD. Prior to backfilling the service line the CONTRACTOR shall request an inspection by the ENGINEER OF RECORD and obtain approval of the service line.

Alternative methods such as hydraulic jacking; air jetting; piston mole; etc., may be used to install water service lines if approved by the ENGINEER OF RECORD.

The proposed method must be approved by the governmental agency having jurisdiction over the work area and the CONTRACTOR must demonstrate that, in the opinion of the ENGINEER OF RECORD, the method is suitable for local soil and ground conditions.

To be found suitable for local conditions, the method must be demonstrated to perform within acceptable horizontal and vertical accuracy limits, must not compress soil beyond acceptable limits, and must not leave voids in the soil. Water jetting shall not be permitted. Final installation of the service pipe must be in accordance with manufacturer's recommendations and no joints or fittings shall be allowed under roadway surfaces.

3. Replacement Water Mains

Existing water mains shall be kept in service until all water services have been connected to the new mains. The CONTRACTOR shall repair all water services damaged during the installation of the new water mains. Only after the new mains have been accepted and put into service, will service connections be made to the new mains.

The connection of existing service lines to the new mains shall be made within the street rights-of-way or within the easements, utilizing the existing curb stops. All existing lead water service lines shall be abandoned and new water service lines installed from the new water main to the existing curb stops.

Backfill, method of construction under pavements, and new water service lines shall be as specified in Article 3.03.K.2. of this Section.

3.4 FIELD QUALITY CONTROL

A. Hydrostatic Testing

After the pipe has been laid and backfilled, the pipe shall be hydrostatically tested for leakage. The CONTRACTOR shall furnish the pump, pipe connection, hydrants, valves and any other necessary apparatus including gages and meters and all personnel necessary for conducting the test. Before applying the test pressure, all air shall be expelled from the pipe. If necessary to accomplish this, taps shall be made at points of higher elevation and afterwards plugged. The test shall be made in accordance with the Hillsborough County Technical Specifications for Water Mains. Any faulty pipe fitting, gate valves or other accessories which permit leaks during testing shall be replaced by the CONTRACTOR with sound material and the test shall be repeated until specified requirements are met. The maximum permissible leakage measured by a water meter for the section of main tested under pressure, shall not exceed the rate specified by the formula indicated in Section 4.2.2 of AWWA Specification C600. Copies of test data shall be forwarded to the OWNER AND THE ENGINEER OF RECORD.

B. Water for Testing

Water for testing shall be obtained from a potable water supply. The CONTRACTOR shall provide all water required at his own expense and shall make all necessary arrangements with the authority which controls the source of water system and shall be governed in his use of water by all rules and regulations imposed thereon by said authority. The CONTRACTOR shall provide and remove temporary connections between the source water system and the mains constructed under this Contract. All temporary connections shall meet the approval of the ENGINEER OF RECORD, the authority controlling the source water system and Public Health authorities having jurisdiction.

C. Defective Work

Any portion of the pipe which does not meet the leakage requirements specified shall be corrected/repared at the CONTRACTOR's expense by the methods meeting the approval of the ENGINEER OF RECORD AND THE OWNER. Any extra testing or sampling required because of apparent deficiencies shall be at the CONTRACTOR'S expense.

3.5 CLEANING AND DISINFECTION

A. Flushing

After completion of water main installation, flush the new mains, valves, hydrants and appurtenances completely and as acceptable to the ENGINEER OF RECORD. Heavily chlorinated water discharged from a disinfected system shall be controlled adequately to protect any surface water resource or adjacent property from potential environmental damage, or from creation of a hazard to traffic. Remove and dispose of all temporary installations at completion of the flushing operation.

After flushing, and prior to final approval of the system, the CONTRACTOR shall pump down all fire hydrants and verify that the hydrant valve is properly seated to prevent the hydrant standpipe from

filling with water.

B. Disinfection

After satisfactory hydrostatic testing and flushing of the new water main, disinfect the complete system by introduction of a chlorine-water solution throughout the water main piping. The liquid mixture shall be applied by means of a solution-feed chlorinating device. The chlorine solution shall be applied through a corporation stop at the beginning of the main or valved section thereof. A slow flow of water shall be let into the main approximately at the point of injection of the chlorine solution, at a rate such that the chlorine dosage of the entering water shall be at least 50 parts per million. An open discharge shall be maintained at the far end of the section of main being chlorinated, and the introduction of chlorine solution and water shall continue until the water discharging at the far end shall carry the required dosage of chlorine. As the main is filled with chlorinated water, each outlet from the main shall be opened and sufficient water drawn off to assure that the full dosage of chlorine reaches each outlet.

Back pressure causing a reversal of flow in the main being chlorinated shall be prevented, and pressure in the main shall be held down to a point which will make it impossible for chlorinated water to be forced into other sections of the main or water system.

The chlorine treated water shall remain in the main at least 24 hours, and at the end of that time the chlorine residual at pipe extremities and other representative points shall be at least 25 ppm. If the chlorine residual shall be less than 25 ppm at the end of 24 hours, further application of chlorine shall be made and the retention period repeated until the required 25 ppm residual is obtained.

Should the initial treatment of all or any section of the mains, in the opinion of the ENGINEER OF RECORD, prove ineffective, the chlorination procedure shall be repeated until confirmed tests show that water sampled from the new mains conforms to the foregoing requirements.

The CONTRACTOR shall collect water samples and cause analyses to be made at his own expense. Testing laboratory and sample collection shall meet the approval of public health authorities having jurisdiction. Copies of testing data and public health authority's acceptance shall be forwarded to the owner.

C. Water for Cleaning and Disinfection

Water for cleaning and disinfection shall be obtained from a potable water supply. The CONTRACTOR shall provide all water required at his own expense and shall make all necessary arrangements with the authority which controls the source of water system and shall be governed in his use of water by all rules and regulations imposed thereon by said authority. The CONTRACTOR shall provide and remove temporary connections between the source water system and the mains constructed under this contract. All temporary connections shall meet the approval of the ENGINEER OF RECORD, the authority controlling the source water system, and Public Health authorities having jurisdiction.

D. Bacteriological Analysis

Prior to placing a water main in service, not less than two (2) consecutive water samples taken 24 hours apart for bacteriological analysis shall be collected and each analysis shall show results meeting state drinking water standards.

The CONTRACTOR shall collect water samples and cause analyses to be made at his own expense. Testing laboratory and sample collection shall meet the approval of public agency having jurisdiction. Copies of testing data shall be forwarded to the OWNER AND THE ENGINEER OF RECORD.

END OF SECTION

SECTION 33 3000 - SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Scope

This Section includes sanitary sewer Work indicated on the Plans complete with pipe, joints, structures, pipe bedding, installation, and television inspection and testing.

- B. Related Work Specified Elsewhere

- 1. Dewatering: Section 31 2319
- 2. Structure Excavation and Backfill: Section 31 2300
- 3. Trenching, Backfill and Compacting: Section 31 2333

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies

- 1. Testing

Testing shall conform to the applicable requirements of State and local authorities having jurisdiction, and shall include such tests as: air, exfiltration and infiltration.

- B. Reference Standards

Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

ANSI - American National Standard Institute

ASTM - American Society for Testing and Materials

FDOT - Florida Department of Transportation

Hillsborough County Technical Specifications

- C. Source Quality Control

Laboratory test each lot, with a minimum of three (3) pieces, each size, material and class of gravity pipe required in the Work.

1.4 SUBMITTALS

- A. Product Data

Submit manufacturer's data to ENGINEER OF RECORD for pipe bulk heading devices in accordance with Article 3.03.E. of this Section. Submit manufacturers Certification and Certified test reports for each size, material and class of gravity pipe required in the Work as per the requirements of and shall be in conformance with the Hillsborough County Technical Specifications.

B. Reports

1. A complete field report of the location of all wyes, risers and sewer services shall be submitted to the OWNER, ENGINEER OF RECORD at the end of each sewer section of the Project or on the last day of each week, whichever occurs first.

The complete field report shall include witnessing by the CONTRACTOR of the ends of all building leads placed. Witnessing shall consist of recording three (3) horizontal distances to the nearest foot from the end of the sewer services to three (3) permanent structures, with the lines of measurement at minimum angles of 45 degrees with respect to one another.

Witnessing shall also include recording of the depth to nearest 2 foot from the invert at the end of the lead to the finish ground above the end of the lead. No payment will be made for unwitnessed installation or for improper witnessed installations.

2. As part of the television inspection, a wye location report shall be submitted to the ENGINEER OF RECORD AND OWNER. The report shall contain the precise location of each wye, notes, photographs, and other pertinent information.
3. Submit two (2) copies of the laboratory test reports required per paragraph 1.02.C. of this Section to the OWNER.

C. Shop Drawings

Shop Drawings shall be provided to ENGINEER OF RECORD on all manholes and connection to manholes as per and shall be in conformance with the Hillsborough County Technical Specifications.

1.5 PRODUCT STORAGE AND HANDLING

A. Storage of Materials

1. Sanitary Sewer Piping

Piping material shall not be stacked higher than four (4) feet. Suitable racks, chairs, and other supports shall be provided to protect preformed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.

2. Gaskets

All joint and sealing materials used in the sanitary sewer system shall be protected from sunlight and stored in cool and clean place until ready for installation.

B. Handling of Material

1. Loading and Unloading

Load and unload piping using suitably approved hoists, skids, etc. Piping shall not be dropped, bumped or allowed to impact against itself. Damaged piping will be rejected by the ENGINEER OF RECORD.

2. Lifting Devices

Lifting devices shall be suited to the Work and shall protect surfaces from damage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Scope

It is the intent of this Article to specify in detail the various types of sewer pipe and joints, which have been indicated throughout the Plans and Specifications. This Article shall not be construed as allowing

any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications.

B. Plastic Pipe System

1. ABS Pipe

- a. Truss pipe shall be ASTM D2680, Acrylonitrile- Butadiene-Styrene (ABS). The pipe shall be of a double wall construction, braced with a truss-type structure with all three (3) formed in one (1) extrusion. The truss voids are filled with lightweight concrete to provide additional compressive strength and bracing.
- b. Solid wall pipe shall conform to ASTM D2751, SDR 23.5, Acrylonitrile-Butadiene-Styrene (ABS).
- c. Joints for Acrylonitrile-Butadiene-Styrene (ABS) composite pipe shall be ASTM D2680, Type S.C., a solvent-cemented joint in which pipe solvent cements into a coupling socket to form the joint closure. Installation of the solvent cement shall be in strict accord with the manufacturer's recommendations.

2. PVC Pipe

- a. All PC Pipe shall be in conformance with the Hillsborough County Technical Specifications
- b. Pipe in sizes 6-inch through 15-inch shall be ASTM D3034 SDR35, and in sizes 18-inch through 27-inch shall be ASTM F679 SDR35, polyvinyl chloride pipe (PVC).
- c. Joints for polyvinyl chloride pipe (PVC) shall be ASTM D3212, push-on type. A joint in which an elastomeric ring gasket is compressed in the annular space between a bell end or socket and a spigot end of pipe.
- d. All pipe and fittings shall be marked in conformance with the Hillsborough County Technical Specifications.

C. Structures

Material for sanitary sewer structures shall conform to the requirements listed below:

1. Clay Brick

Brick shall be ASTM C32, Grade MS, recessed and/or cored .as approved by the ENGINEER OF RECORD.

2. Concrete Brick

Brick shall be ASTM C55, Grade S-11, recessed and/or cored.

3. Precast Concrete Units

Precast concrete units shall conform to ASTM C478, and shall be circular with circular reinforcement. The minimum wall thickness shall be six (6) inches for stack depth sections up to 12 feet and eight (8) inches for depths over 12 feet. Base slab shall be eight (8) inches thick for depths up to 25 feet and 12 inches thick for depths greater than 25 feet.

Precast doghouse sections shall be used for existing sewer 15 inches and smaller on straight-through runs for a depth up to 20 feet and on right angle runs, with a maximum of four (4) cutouts for depths up to 12 feet. Openings in precast doghouse sections shall be cast in the section before curing and no breaking or chipping of sections will be allowed after the section has cured.

The size of the opening shall be cast as indicated on the Plans.

Precast bottom sections shall be cast with the bottom end flat to provide bearing of the full

wall thickness. The openings for sewer pipe shall be cast in the manhole and the bottom section by the manufacturer.

Six (6) inch thru 24-inch connections to manholes shall use a mechanically compressible flexible joint, as indicated on the Plans.

Riser sections of a manhole shall have modified grooved tongue joints with O-ring gaskets or a tongue and groove joint with a butyl rubber based gasket type sealant meeting the requirements of AASHTO M-198 and having a nominal size of 1-inch.

Eccentric cone sections of a manhole shall have modified grooved tongue joints with O-ring gaskets and be provided with 4-stud inserts cast in the top. The top shall have a smooth finished surface.

Concrete grade rings shall have smooth finished top and bottom surfaces. Grade rings shall be provided with O-ring gaskets.

Precast manhole tees will be allowed on straight-through runs with no angle at the manhole and where stubs or openings in manhole are above the tee section.

Precast concrete manhole tee units shall conform to ASTM C76, Class IV and shall be circular with circular reinforcement. The precast tees must be a monolithic pour with wire cage inspection prior to concrete placement. Joints for tee shall be the same as the joints on the sanitary sewer.

4. Manhole Frames and Covers

Manhole frames and covers shall conform to ASTM A48, Class 30, gray iron and shall be of the types and sizes as indicated on the Plans. The castings shall be neatly made and free from cracks, cold sheets, holes and other defects. Surfaces of casting shall be ground to assure proper fit and to prevent rocking.

For manholes using a bolted down frame and cover shall be installed with a bolted waterproof frame with a pressure tight cover as indicated on the Plans.

D. Steel Pipe

Pipe shall conform to ASTM A120, black and hot-dipped galvanized welded and seamless pipe of standard weight.

E. Bolt, Studs, Nuts

Bolt, studs and nuts shall conform to the following ASTM Standards:

Cadmium Plating: ASTM A165, Grade N.S.

Zinc Coating: ASTM A153 or A164, Type G.S.

F. Concrete

The concrete shall conform to the Hillsborough County Technical Specifications no admixtures without ENGINEER OF RECORD'S review.

G. Concrete Reinforcement

In accordance with FDOT Section 931, use ASTM A615, Grade 60 for bars and ASTM A185 for welded wire fabric.

H. Granular Material

Granular material shall be material with having the following gradation limits passing a No. 4 sieve - 95 % (min) passing a No. 200 sieve - 5% (max) and meeting the approval of the ENGINEER OF RECORD

and shall be in conformance with Hillsborough County Technical Specifications.

PART 3 - EXECUTION

3.1 CONTRACTOR'S VERIFICATION

A. Excavation and Bedding

Prior to the installation of any sanitary sewer piping, structures, or materials, examine all trenches and other excavations for the proper grades, lines, levels and clearances required to receive the new Work. Ascertain that all excavation bottoms, compacted subgrades and piping bedding are adequate to receive the sanitary sewer materials to be installed. Correct all defects and deficiencies before proceeding with the Work.

B. Existing Sanitary Sewers

The CONTRACTOR shall expose the existing sanitary sewer and structures to which the new Work is to be connected and notify the ENGINEER OF RECORD of same. The ENGINEER OF RECORD will verify the vertical and horizontal locations of the existing system and shall inform the CONTRACTOR as to the necessary adjustments required to align the new sanitary sewer work with the existing system.

C. Pipe Class and Joints

Prior to the installation of any sanitary sewer piping, ascertain that the class of pipe, joint material and bedding are as specified herein and as indicated on the Plans.

3.2 PREPARATION

A. Pipe Ends

The outside surface of the spigot end and the inside surface of the bell end shall be cleaned and free of any foreign material, other than sealant recommended by the manufacturer, prior to installation.

B. Examination of Material

All pipe, frames, covers, accessories, and appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective or damaged material will be rejected by the ENGINEER OF RECORD.

3.3 INSTALLATION

A. General

1. Pipe Bearing

Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length.

2. Pipe Cutting

Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square-cut end without damage to the pipe and that minimize airborne particles shall be employed. Pipe cutting shall be performed using the recommendations of the manufacturer of the type of pipe materials being cut and according to the best trade practices. When cutting of pipe or fittings, care shall be taken to prevent damage to the lining and the exterior surface. Damage to either shall be cause for rejection of complete section.

3. Dewatering

During the preparation of the pipe bedding and until the trench has been satisfactorily

backfilled, the trench shall be kept free of water and sewage. A dewatering system, in accordance with Section 02140, Dewatering, shall be provided and maintained by the. The dewatering system shall remain in operation as directed by the ENGINEER OF RECORD.

4. Pipe Laying

a. Rigid Pipe

Installation of rigid pipe shall conform to ASTM C12. All pipe shall be laid to the line and grade called for on the Plans. Each pipe as laid, shall be checked by the CONTRACTOR with line and grade pole or laser system to insure that this result is obtained. When employing a laser system, the CONTRACTOR shall have an alternate and independent means of checking the line and grade. The finished work shall be straight and shall be sighted through between manholes.

Construction shall begin at the outlet end and proceed upgrade with spigot ends pointing in direction of flow. Bell holes shall be excavated so that the full length of the barrel will bear uniformly on the pipe bedding material.

All pipe shall be jointed by means of a resilient gasket. The resilient gasket shall be lubricated and installed to form a watertight joint between the bell and spigot of the pipe. The bell of the pipe in place shall be cleaned and properly lubricated prior to the installation of the next pipe spigot. The pipe shall be centered in the bell or groove. After the spigot is well entered into the bell and the gasket is fully compressed and brought to final shape, check the gasket for proper position around the full circumference of the joint. Complete installation by pushing the pipe tightly together to form a smooth and continuous invert.

Mechanical means shall be used for pulling home all pipe where manual means will not result in pushing and holding the pipe home. Mechanical means shall consist of a cable placed inside of the pipe with a suitable winch, jack, or come along for pulling the pipe home and holding the pipe in position.

After laying of pipe, care shall be taken so as not to disturb its line and grade. Any pipe found off grade or out of line shall be relaid. When adapters are required to properly connect the new pipe to an existing pipe of other materials or manufacture, the nominal inside diameter of adapters shall be the same size as the nominal pipe diameter to which it is to be connected.

b. Flexible Pipe

Installation of flexible pipe shall conform to ASTM D2321.

Except as otherwise specified herein, installation of ABS shall be made in complete accordance with the published installation guide of the pipe manufacturer. Unless specified otherwise on the plans, all PVC pipe shall be installed with Class "C" bedding and shall be in conformance with in conformance with the Hillsborough County Technical Specifications.

Joints for ABS pipe shall be made by first applying a coat of primer to the inside of the socket and to the outside of the spigot end of the pipe. Without delay, apply a coating of cement to the same surfaces in sufficient quantity that when the spigot is fully inserted into the socket, a bead of excess cement will form around the complete circumference of the outside junction of the spigot and socket. Remove the excess cement and allow the assembly to cure 24 hours.

Joints for PVC pipe shall be made by using a lubricant immediately before joining. Apply lubricant only on the spigot, coating the entire circumference of the spigot bevel plus 1-inch behind the taper. Insert lubricated spigot into the bell, and using normal force insert spigot until insertion stripe mark is flush with the bell entrance.

When jointing ABS pipe, rotate the pipe when inserting it approximately 1/4 to 2

turns.

Taps to ABS and PVC pipes, where fittings are not provided, shall be made with chemically welded saddle fittings unless otherwise indicated on the Plans. Holes for saddle connections shall be by mechanical hole cutters, or by keyhole saw or saber saw. Holes for saddles shall be laid out with a template and shall be deburred and beveled to provide a smooth hole shaped to conform to the fitting. After the cemented saddle has been fixed to the pipe surface, quickly install band clamps each side of the saddle and tighten.

5. Pipe Bedding

a. Rigid Pipe Bedding

Pipe bedding shall conform to ASTM C12, except as noted.

Class A

The pipe shall be bedded in crushed stone bedding material placed on the trench bottom. The bedding material shall have 100% passing a 3/4 inch sieve and 95% retained on a No. 4 sieve. The bedding shall have a minimum thickness beneath the pipe of six (6) inches or 1/4 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline.

The top half of the pipe shall be covered with a monolithic plain concrete arch having a thickness of at least four (4) inches or 1/4 of the inside diameter of the pipe, whichever is greater, at the pipe crown and a minimum width equal to the outside diameter of the pipe plus eight (8) inches or 1-1/4 of the diameter of the pipe, whichever is greater.

Class B

The pipe shall be bedded in crushed stone bedding material placed on the trench bottom. The bedding material shall have 100% passing a 3/4 inch sieve and 95% retained on a No. 4 sieve. The bedding shall have a minimum thickness beneath the pipe of six (6) inches or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline. Backfill from pipe horizontal centerline to a level not less than 12 inches above the top of the pipe shall be select sand backfill meeting the requirements of granular material.

This material shall be placed in 6-inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.

Class C

The pipe shall be bedded in select sand backfill, approved by the ENGINEER OF RECORD, meeting the requirements of granular material, placed on the trench bottom. The bedding shall have a minimum thickness beneath the pipe of six (6) inches or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches above the top of the pipe. This material shall be placed in 6-inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.

b. Flexible Pipe Bedding

Pipe bedding shall conform to ASTM D2321, except as noted.

Class I

The pipe shall be bedded in crushed angular stone material placed on the trench bottom. The bedding shall have 100% passing a 3/4 inch sieve and 95% retained on a 1/4 inch sieve.

The bedding shall have a minimum thickness beneath the pipe of six (6) inches, and shall extend up the sides of the pipe until the top of pipe is covered by a minimum thickness of 12 inches.

Where allowable trench widths are exceeded, Class I bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

A continuous and uniform bedding shall be provided in the trench for all buried pipe.

Class II

The pipe shall be bedded in crushed angular stone material placed on the trench bottom. The bedding shall have 100% passing a 3/4 inch sieve and 95% retained on a 1/4 inch sieve. The bedding shall have a minimum thickness beneath the pipe of six (6) inches, or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline. Backfill from pipe horizontal centerline to a level not less than 12 inches above the top of the pipe shall be select sand backfill approved by the ENGINEER OF RECORD, meeting the requirements of granular material. This material shall be placed in 6-inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.

Where allowable trench widths are exceeded, Class I bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

Continuous and uniform bedding shall be provided in the trench for all buried pipe.

Class III

The pipe shall be bedded in select sand backfill, approved by the ENGINEER OF RECORD meeting the requirements of granular material, placed on the trench bottom. The bedding shall have a minimum thickness beneath the pipe of six (6) inches or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches above the top of the pipe. This material shall be placed in 6-inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of the pipe.

Where allowable trench widths are exceeded, Class III bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

Continuous and uniform bedding shall be provided in the trench for all buried pipe.

B. Manhole Structures

Construct sanitary sewer manhole structures to the grades, lines and levels indicated on the Plans, or as specified herein. Structures shall be complete with concrete bases, reinforcing, frames, covers, and adjustment rings, as shown and as required for a complete installation. Sanitary manholes as called for on the Plans shall carry a stub opening as specified herein. Wye openings in manholes are prohibited unless indicated on Plans. Sanitary sewer structures shall conform to the dimensions indicated on the Plans and as described below.

Manholes shall be completed and ready for final inspection either before 400 feet of additional sewer construction is completed or within one (1) week after the manhole is constructed, whichever comes first.

1. Brick

Prior to laying, all brick shall be thoroughly wetted and the surfaces allowed to dry only sufficiently to prevent slippage on the mortar. Broken or chipped brick shall not be used on

the face of the structure.

Brick shall be laid in neat, even consecutive courses with full and close mortar joints. Courses shall be level throughout, except as shown or otherwise required. Stagger joints in adjoining courses by 2 a brick as nearly as practicable. At least one (1) course in every seven (7) shall be stretcher courses with intervening courses laid as headers. Length of brick closure pieces shall be not less than the width of one (1) whole brick and, wherever practicable, closures as headers, shall be made from whole brick.

Unless otherwise indicated, joints shall be not more than 2 inch thick and shall be of a uniform thickness throughout the structure. Joints shall be provided as indicated on the Plans. Exposed surfaces shall be true and smooth. Rake all joints to receive plaster coat.

Prior to applying plaster coat, brick shall be thoroughly wetted with water and the surface allowed to dry sufficiently to effect proper bonding.

2. Concrete Block

The first course of concrete block shall be placed on the prepared base in a full bed of mortar. Mortar joints shall be full and closed in all courses. Courses shall be level throughout. Stagger joints in adjoining courses by 2 the length of the block as nearly as practicable.

Joints shall be uniform in thickness throughout the structure. Strike all joints and properly point to provide true, smooth surfaces.

Prior to applying plaster coat, block shall be thoroughly wetted with water and the surface allowed to dry sufficiently to effect proper bonding.

3. Precast Concrete Units

Construct as detailed on the Plans.

Where precast doghouse sections cannot be used, the manhole shall be brick or block to eight (8) inches above top of highest pipe.

4. Plaster Coat

Cement mortar plaster coat shall be applied to the exterior surfaces of the brick and/or concrete block sections of all manholes indicated on the Plans. Plaster coat shall be 2 inch thick.

5. Castings

Provide and install all iron covers, frames, adjusting rings, and anchors to the elevation indicated on the Plans, or as specified herein. Castings shall be set on 1-inch diameter rubber O-ring gasket, resting on adjustment rings. The casting shall be anchored to the precast concrete cone section as indicated on the Plans.

6. Inlet and Outlet Pipe

Pipe, 6-inch thru 24-inch diameters, shall be connected to manholes using an approved mechanically compressible flexible joint as indicated on the Plans. The pipe shall be properly supported with compacted sand backfill from undisturbed ground so that any settlement will not disturb the connection.

7. Flow Channel

Concrete flow channels shall be constructed in each manhole, as indicated on the Plans. For manholes with outlet pipe diameter of 24 inches or less, the concrete flow channel shall be constructed up to the springline of the pipe, with a 3/4 inch to 1-1/4 inch gap provided at the pipe ends to maintain joint flexibility.

8. Stub Opening

Stub openings shall be at least two (2) pipe, with a minimum length of ten (10) feet, and the first joint located approximately 18 inches from the outside manhole wall. The end of the stub shall have a manufactured bell, which shall be plugged with a watertight manufacturer plug that is blocked to prevent movement.

C. Vent Assembly

Provide all materials and construct vent assemblies where indicated on the Plans. Install all piping, fittings, joints, vents, etc. as detailed. Vent assemblies shall be installed on undisturbed earth and provided with restraints as indicated on the Plans, as specified herein and as required for a complete installation. Vent assemblies shall be connected to manholes as indicated on the Plans.

D. Drop Connection Assembly

Provide all materials and construct drop connection assembly where indicated on the Plans. Install all piping, fittings, joints, etc., as detailed. Tapping of existing manholes for drop connections shall be made by drilling holes through the wall of the manhole at 4-inch centers along the periphery of the opening, to create a plane of weakness joint, before breaking out section. Non-shrink grout shall be used to seal the opening and a 3,500 psi concrete collar 12 inches thick shall be poured around the pipe. Drop connections to existing or new manholes shall be made as indicated on the Plans.

E. Bulkheads

A solid masonry or approved water and airtight bulkhead shall be placed at each point of beginning and at each stub that is constructed or as indicated on the Plans.

At the completion of construction and testing, all the bulkheads shall be removed, unless otherwise indicated on the Plans or as directed by the ENGINEER OF RECORD.

F. Wyes

One (1) 6-inch precast wye or tee branch shall be provided for each lot or parcel 100 feet or less in width that is served by the sewer or every hundred feet for lots or parcels in excess of 100 feet in width that is served by the sewer, unless otherwise indicated on the Plans or specified.

In all cases, unless otherwise indicated, wyes shall be placed as near as practical to the lower 1/3 point of vacant lots or parcels to be served, and it shall be the responsibility of the CONTRACTOR to see that the wyes are so placed. Wyes to developed lots or parcels shall be placed as directed by the ENGINEER OF RECORD.

If the CONTRACTOR fails to place any wyes as herein outlined he shall return to the site and place additional wyes, in an approved manner, at his expense.

If a concrete pipe with an inset opening is being used, a compression type joint shall be cast into bell end of the opening. Wye openings shall be closed with a precast 6-inch stopper, as recommended by the manufacturer, to make a watertight closure.

G. Risers

Risers shall be installed where the sewer is more than 12 feet below the established grade or future grade, and carried to between nine (9) and ten (10) feet of the established grade or future grade, as indicated on the Plans. Six (6) inch pipe with approved compression type joints, or equal cast-in-bell joints with similar fittings shall be installed in the manner indicated on the Plans.

Riser openings shall be closed with a precast stopper, as recommended by the manufacturer, to make a watertight closure.

H. Services

All services shall be 6-inch diameter pipe and shall be laid on a uniform slope of 1/8 inch per foot

unless greater slope will provide depth considered adequate by the ENGINEER OF RECORD.

Services shall be provided to within 1-foot of property line for all lots or parcels on both sides of the street, unless otherwise indicated on the Plans. If in an easement, the service shall be provided to within 1-foot of the easement line.

Service depth, shall be as shown by the Plans. or as directed by the ENGINEER OF RECORD.

Services under or within five (5) feet of concrete or asphalt pavements shall be installed by boring or tunneling.

Each service shall be closed with a precast stopper, as recommended by the manufacturer, to make a watertight closure.

I. Wye, Riser or Service Marker

Prior to the backfilling of a wye, riser or service, a 2"x 2" (minimum cross section) wooden marker shall be placed from a point immediately in front of the service connection to 1-foot below the finish ground surface. The top of the marker shall be painted green, and labeled sanitary sewer service with station number. DO NOT rest the marker on any portion of the service connection or stopper.

3.4 FIELD QUALITY CONTROL

A. General

After all the pipe, structures, and services have been laid, constructed and backfilled, the system shall be cleaned, final inspected and tested. The cleaning, inspection and testing shall consist of the following parts: cleaning, first inspection, television inspection and testing.

A manhole section is defined as the length of sewer connecting two manholes. Cleaning of sanitary sewer lines shall be conducted on the lines specified. The designated sanitary sewer lines shall be cleaned using high velocity, mechanically powered or hydraulically propelled sewer cleaning equipment as specified. Selection of the equipment used shall be based on the conditions of the lines at the time the work commences. Cleaning of sewer lines shall be accomplished by trapping and collecting all sand, debris, grease and other material, at the next manhole downstream of the line being cleaned, and removal and proper disposal of said materials.

The cleaning operations shall also provide a means by which the sewer line can be threaded, i.e., a cable inserted in the line so that the television camera may be pulled through.

The first inspection shall be completed and all repairs made in ample time so that the television inspection of the underground portion of the system, as hereinafter defined, can be completed within four (4) weeks of the completion of the construction. Television inspection shall be considered completed when the necessary construction repairs have been made and the installation retelevized when required, and the system is acceptable for the testing phase. When retelevision is necessary, an additional two (2) weeks will be allowed for completion. Testing of the system as hereinafter described shall immediately follow the television inspection and shall be completed within a 2-week period.

Failure to maintain a schedule in compliance with the terms of this item will automatically cause the stoppage of other work at the particular site in question until such time as the final inspection of the completed underground portion of the system has progressed to within acceptable limits.

1. Sewer Line Cleaning

The designated sewer manhole sections using equipment and methods approved satisfactory to the ENGINEER OF RECORD and OWNER, shall be cleaned using high-velocity jet equipment for 18-inch diameter sewer and smaller. The equipment shall be capable of removing dirt, grease, rocks, sand, roots and other materials and obstructions from the sewer lines and manholes, and restore the sewer to a minimum of 95 percent of the original carrying capacity, as required for first inspection, and restore the sewer to a minimum of 95 percent of the original carrying capacity, as required for first inspection.

The equipment shall have a selection of two or more high-velocity nozzles capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun capable of producing flows from fine spray to a solid stream for washing and scouring manhole walls and floor. The equipment shall carry its own water tank, auxiliary engines, pumps and hydraulically driven hose reel.

The CONTRACTOR shall contact the OWNER regarding a source of water. All costs incurred in obtaining and delivering the hydrant meter water shall be borne by the CONTRACTOR. A gate valve shall be used by the CONTRACTOR when operating any hydrant. Proper hydrant operating procedures shall be obtained from the local water department.

Precautions shall be taken to insure that the water does not cause damage of flooding to the public or private property being served by the manhole section involved. Sewers or service laterals damaged as a result of the CONTRACTOR'S operations shall be immediately repaired by the CONTRACTOR at no cost to the Owner. Damage caused by the materials (liquid or solid) that are blown or pushed back into resident's homes through the sewer laterals which is the responsibility of the CONTRACTOR at no cost to the Owner.

All sludge, dirt, sand, roots, rocks, grease, and other solid or semi-solid material resulting from the cleaning operation shall be trapped and removed at the down stream manhole of the section being cleaned. Passing material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment shall not be permitted.

Under no circumstances shall sewage or solids be dumped onto the ground surface, streets or into ditches, catch basins or storm drains. All solids or semi-solids resulting from the cleaning operations shall be vacuumed into a water tight vacuum truck. The excess liquid shall be returned to the sewer system. The CONTRACTOR shall not be allowed to accumulate debris, sand, etc., on the site of work, except in totally enclosed containers and as approved by the ENGINEER OF RECORD and OWNER. Disposal of the solids or semi-solids shall be at a suitable site and paid for by the CONTRACTOR. All materials shall be removed from the site no less than at the end of cleaning operations shall be removed from the site and disposed of at a location approved by the Hillsborough County Utilities Department.

CONTRACTOR will transport to a Hillsborough County disposal site. Cost shall be borne by the CONTRACTOR. Disposal of all debris will be arranged for and paid for by the CONTRACTOR.

If there is interference in the sewer line that will not allow the cleaning equipment to pass, then the equipment shall be backed out of the line and an attempt shall be made to clean the line from the manhole at the other end. If the entire length of the sewer line cannot be cleaned, the CONTRACTOR shall take the necessary steps to cause the cleaning and televising work to proceed at no cost to the Owner.

Should the cleaning equipment become lodged within the pipe or manhole, the CONTRACTOR shall take whatever steps are necessary to quickly remove the equipment and restore any damages to approved conditions.

Cleaning logs, required as a part of the cleaning work, shall be produced by the CONTRACTOR and shall be printed records which will clearly identify the work performed including documentation of the degree of cleaning required. The logs shall be transmitted to and become the property of the OWNER at the end of the project.

2. First Inspection

The CONTRACTOR shall have the underground portion of the sewer system cleaned and ready for the first inspection within two (2) weeks after the completion of each 2,000-foot section of sewer installed.

The first inspection shall consist of a visible and audible check of the sewers and manholes to

ascertain, all lift holes jointed, the channeling of the manhole bottoms completed, all visible or audible leaks stopped, all pipe has been placed straight and true to the proper grades and elevation, the required adjusting rings and frame and cover properly installed, all trenches and structures backfilled in a workmanlike manner and that the system has been thoroughly cleaned.

The first inspection shall be considered completed when all the repairs have been made and the system is ready for television inspection.

3. Television Inspection

The CONTRACTOR shall provide for television inspection of the various sanitary sewer lines installed under this Contract. The CONTRACTOR shall arrange for, engage and pay all expenses involved for the services of a competent company to perform this television inspection.

The inspection shall be carried out under the direction of the ENGINEER OF RECORD with all television inspection being observed by the OWNER, ENGINEER OF RECORD, and the CONTRACTOR. Any television viewing performed in the absence of the any of the above will not be considered as a part of the final inspection.

The inspection shall involve the visual observation by closed circuit television of all sanitary sewer, six (6) inches in diameter to 24 inches in diameter inclusive, installed as a part of this Contract; digital copy to be turned over to Owner. Inspection shall be video'd in color with date view with accurate footage display and PVC pipe shall have a deflection test using a 72% (go no go) test mandrel of appropriate size, visible on video at all times. Other pertinent data to be recorded on the audio portion of the video shall include owners name, project name and phase number, manhole numbers, and distances between manholes. The inspection shall be performed at a rate of speed which will allow examination of all points of infiltration, cracked or crushed pipe, standing water, defective joints, and misalignment in line or grade, location of all wye openings and any defects or items of poor workmanship which may appear shall be notated on the audio portion of the video. Any items which, in the opinion of the ENGINEER OF RECORD, require repair shall be precisely located and photographed along with a detailed statement of the condition. The CONTRACTOR shall take immediate action to repair all such defects including excessive infiltration at any specific location, even though the infiltration limits as hereinafter specified have not been exceeded for the entire length of sewer being inspected. Dips and sags with 1" or more of trapped water shall be caused for rejection and shall be corrected to meet required specifications. Following completion of the correction, the OWNER or the ENGINEER OF RECORD, will require a second television inspection of any repaired areas.

The CONTRACTOR shall arrange for and pay all costs involved in performing this reinspection at no cost to the Owner.

As a part of the television inspection, the precise location of each wye shall be noted in relation to the downstream manhole with each lateral being viewed "up" for a maximum of one (1) joint. These locations shall be entered on the Wye Location Sheet "a" supplied by the CONTRACTOR and verified by comparison with the locations as established at the time of construction. Any discrepancies in location between the field location record and the television inspection record shall be reconciled and the proper location of the wye determined as a part of the television inspection. Two (2) copies of all notes, photographs, wye locations and other pertinent information shall be made as a part of the television inspection, and shall be turned over to the OWNER within ten (10) days. Each section of work must be kept on a separate video upon the completion of the inspection of each line.

Complete logs of TV work must be kept and must include accurate measurements of line length, lateral connections, problems, etc. Logs must accurately show line section, flow direction, measurement direction, date, time, operator, and street name. Lateral connections and problems must be listed using clock reference for location. Hammer tap connections must be so listed and their direction, either right or left, must be indicated. Depth and conditions of all manholes must be noted on logs. Logs shall be produced by the CONTRACTOR and shall be printed records which will clearly show the location of each joint,

service connection, repair, damaged pipe, roots and other discernable features.

Lighting for the camera shall be suitable to allow a clean picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the OWNER and, if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.

The camera shall be moved through the line in either direction with the use of an articulating head camera, stopping when necessary to permit proper documentation of the sewer's condition. In all cases, the camera will be stopped and positioned at each lateral to view the greatest distance possible up each service. In no case will the television camera be pulled at a speed greater than 30 feet per minute.

Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If, during the inspection operation, the television camera will not pass through the entire manhole section, the CONTRACTOR shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire manhole section, the inspection shall be delayed until the CONTRACTOR corrects the problem at no cost to the OWNER.

When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communications between members of the crew.

Measurement between manhole centers shall be above ground, by the CONTRACTOR, by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a working meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the OWNER.

Problems must be rated, by operator, on a scale of one to ten, with one meaning minor and ten being major. Accurate "tape footage" must be kept and listed for all tap locations and for all problems encountered. Logs must contain all pertinent information so as to allow accurate cross-indexing and cataloging of all accumulated data. Line sections are to be plugged and all TV work must be accomplished in dry pipe.

If any low sections are encountered it will be necessary for CONTRACTOR to "jet" any standing water way to allow for inspection of 360 degrees of all pipes.

Approval for payment for installed pipe will be made only after a complete review of all submitted logs and videos for the appropriate line sections. Should the ENGINEER OF RECORD determine, upon review, that the data submitted is inadequate due to log errors or omissions, improper or insufficient cleaning, equipment malfunctions, poor video quality, poor visibility of the pipe conditions, excessive flow, poor video quality such as breaks in the continuous recording or poor or inadequate audio recording, no sound, no measurements or other problems resulting in inaccurate or incomplete data, the CONTRACTOR shall schedule whatever inspection, with any required cleaning, for the particular line section. The CONTRACTOR shall perform the rework within five (5) working days after receipt of the written notification by the OWNER.

Television inspection shall be considered completed when the necessary construction repairs have been made and the installation retelevised when required, and the system is acceptable for the testing phase.

Any retelevising of the lines due to poor cleaning, video quality or insufficient logs as determined by the ENGINEER OF RECORD shall be at the expense of the CONTRACTOR.

4. Testing

The CONTRACTOR shall provide the necessary supervision, labor, tools, equipment and the materials necessary for the tests which shall be conducted in the presence of the ENGINEER OF RECORD or performed by a reputable test lab in conformance with the Hillsborough County Technical Specifications. The ENGINEER OF RECORD shall be notified two (2) working days in advance of all testing. The following tests shall be performed and approved prior to placing any system in service:

Leakage tests shall be conducted on all new sewer lines and existing lines which have not been previously approved. All sewers shall be subjected to air, exfiltration or infiltration tests, or a combination of same, prior to acceptance. All sewers over 24-inch diameter shall be subjected to infiltration tests. All sewers of 24-inch diameter or smaller, where the groundwater level above the top of the sewer is over seven (7) feet, shall be subjected to infiltration tests. All sewers of 24-inch diameter or less, where the groundwater level above the top of the sewer is seven (7) feet or less, shall be subjected to air tests or exfiltration tests.

a. Exfiltration/Infiltration Test

If an exfiltration test is performed, the maximum exfiltration rate shall be the same as the permitted from infiltration. For the purposes of exfiltration testing, the internal water level shall be equal to the highest structure service water level plus two (2) feet as measured from the top of pipe.

Maximum allowable infiltration shall not exceed 200 gallons per inch of diameter per mile of pipe between manholes per 24 hours for any section of the system and shall include the infiltration from all manholes and other appurtenances.

b. Air Test

The procedure for air testing of sewers shall be in conformance with the Hillsborough County Technical Specifications:

All services shall be properly plugged and blocked to withstand the air pressure. The sewer line shall be tested in increments between manholes. The line shall be cleaned and plugged at each manhole. Such plugs shall be designed to hold against the test pressure and shall provide an airtight seal. One (1) of the plugs shall have an orifice through which air can be introduced into the sewer. An air supply line shall be connected to the orifice. The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer. The pressure gauge shall have a minimum diameter of 3-1/2 inches and range of 0-10 psig. The gauge shall have minimum divisions of 0.10 psig and an accuracy of + 0.04 psig.

The sewer shall be pressurized to 4.0 psig greater than the greatest back pressure caused by groundwater over the top of the sewer pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize between 3.5 and 4.0 psig. If necessary, air shall be added to the sewer to maintain a pressure of 3.5 psig or greater.

After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is less than 3.5 psig, or such other pressure as is necessary to compensate for groundwater level.

The time required for the air pressure to decrease 1.0 psig during the test shall not be less than the time shown in the tables listed in the NCPI Publication titled Low Pressure Air Test for Sanitary Sewers.

Manholes on sewers to be subjected to air tests shall be equipped with a 1/2 inch diameter galvanized capped pipe nipple extending through the manhole wall, three (3) inches into the manhole and at an elevation equal to the top of the sewer pipe. Prior to the air test, the groundwater elevation shall be determined by blowing air through the pipe nipple to clear it and then connecting a clear plastic tube to the pipe

nipple. The tube shall be suspended vertically in the manhole and the groundwater elevation determined by observing the water level in the tube. The air test pressure shall be adjusted to compensate for the maximum groundwater level above the top of the sewer pipe to be tested.

After all tests are performed and the sewer is ready for final acceptance, the pipe nipple shall be removed and the hole in the manhole wall shall be plugged with hydraulic cement.

If a sewer fails to pass any of the previously described tests, the CONTRACTOR shall determine the location of the leaks, repair them and retest the sewer. The tests shall be repeated until satisfactory results are obtained.

B. Deflection Test for Plastic Pipe

Plastic pipe shall be tested for deflection, but no sooner than thirty days following the backfilling of the pipe. Maximum allowable deflection (reduction in vertical inside diameter) shall be five (5) percent. Locations with excessive deflection shall be excavated and repaired by re-bedding and/or replacement of the pipe.

3.5 SCHEDULES

A. Allowable Pipe Materials

Allowable pipe materials for this Project, based on size and depth of cut, are listed in the attached schedule or on the Plans. The schedule also lists pipe strength and bedding class requirements for the various types of pipe.

END OF SECTION

SECTION 33 4000 - STORMWATER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Scope

This Section includes storm sewer Work indicated on the Plans complete with pipes, joints, structures, pipe bedding, final inspection and appurtenances.

1. Measurement and Payment:
2. Dewatering: Section 31 2319
3. Structure Excavation and Backfill: Section 31 2300
4. Trenching, Backfill and Compacting: Section 31 2333

1.3 QUALITY ASSURANCE

- A. Reference Standards

Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

ANSI - American National Standard Institute

ASTM - American Society of Testing & Materials

AASHTO - American Association of State Highway Transportation Officials

FDOT - Florida Department of Transportation

Hillsborough County Technical Manual

SWFWMD – Southwest Florida Water Management District

- B. Source Quality Control

Laboratory test not less than one (1) percent, with a minimum of three (3) pieces each size, material and class of gravity pipe required in the Work.

1.4 REGULATORY REQUIREMENTS

- A. All work pertaining to this section for Work to be performed within a Florida Department of Transportation Right-of-Way shall be performed in accordance with the Florida Department of Transportation Standard Specifications for Road & Bridge Construction, latest edition.
- B. All work pertaining to this section for Work to be performed within the Hillsborough County Right-of-Way shall be performed in accordance with the Hillsborough County Stormwater Management Technical Standards.
- C. All work pertaining to this section shall comply with provisions authorized through Part IV, Chapter 373 Florida Statutes, and other applicable regulations.

1.5 SUBMITTALS

A. Reports

1. A complete field report accurately recording the actual locations of pipe runs, connections, and invert elevations shall be submitted to the OWNER and the ENGINEER OF RECORD and the at the end of each installed section of the work or on the last day of each week, whichever occurs first. Upon completion of all work four complete sets of drawings and information conforming to the standards set out on the SWFWMD Statement of Completion and Transfer to Operation Entity, shall be submitted to the ENGINEER OF RECORD and the OWNER within 10-days after completion of construction.
2. Submit two (2) copies of the laboratory test reports required per Paragraph 1.02.B. of this Section to the OWNER and the ENGINEER OF RECORD.

B. Shop Drawings

Complete Shop Drawings for all materials pertaining to this section shall be submitted to the ENGINEER OF RECORD AND THE OWNER

1.6 PRODUCT STORAGE AND HANDLING

A. Storage of Materials

1. Storm Sewer Piping

Piping material shall not be stacked higher than four (4) feet or as recommended by the manufacturer, whichever is lowest. Suitable racks, chairs, and other supports shall be provided to protect preformed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.

2. Gaskets

Jointing and sealing materials used in the storm sewer system shall be protected from sunlight and stored in as cool and clean a place as practicable until ready for application.

B. Handling of Material

1. Loading and Unloading

Load and unload materials using suitable approved equipment. Material shall not be dropped, bumped or allowed to impact against itself. Damaged material will I be rejected by the ENGINEER OF RECORD.

2. Lifting Devices

Lifting devices shall be suited to the Work and shall protect surfaces from damage.

PART 2 - PRODUCTS

2.1 MATERIALS

It is the intent of this Article to specify in detail the various types of storm water conduit and joints, which have been indicated throughout the Plans and Specifications. This Article shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications.

A. Concrete Pipe

1. Non-Reinforced Concrete Pipe Systems

a. Pipe

Pipe shall conform to ASTM C14, extra strength Class 3 non-reinforced concrete pipe.

b. Joints

Premium joints for circular pipe shall conform to ASTM C443 limited as follows: Section 5.1 of C443, Physical Requirements for Gaskets, shall be replaced with Section 6.9 of C361, Rubber Gaskets. Also, Section 5 of C443 shall be limited to a modified grooved tongue to receive a rubber gasket. The modified grooved tongue and bell ends of the pipe shall be made smooth and shall not have over a 3-1/2 degree slope for sizes 10-inch to 24-inch formed to fit the rubber gasket to tolerances as determined by the manufacturer. Pipe tongue shall not be out of round by more than + 1/16 inch. The thickness of the bell shall be at least 90% or the pipe wall thickness or 2-1/2 inches, whichever is greater. Pipe bell and tongue shall be reinforced. The reinforcing steel shall be lapped a minimum of two (2) inches.

Premium joints for elliptical pipe shall conform to FDOT Specification Section 942-2.

2. Reinforced Concrete Pipe

a. Pipe

Reinforced concrete pipe shall conform to ASTM C76. Ten (10) inch diameter, shall have steel and concrete as specified for 12-inch diameter ASTM C76, Class III thru V, Wall B, circular reinforced. Twelve (12) inch thru 30-inch diameter pipe shall be Class III thru V, Wall B, circular reinforced. Thirty-six (36) inch thru 108-inch diameter pipe shall be Class III thru V, Wall B, circular reinforced or elliptical reinforced. When elliptical reinforcement is used, the following method of indexing the steel and the pipe barrel shall be used.

A dummy lift pin form shall be set in the outer pipe wall form projecting into the pipe wall a minimum of 1-3/4 inches and a maximum of 2-1/4 inches. An additional spacer chair shall be welded to the elliptical steel cage at the proper location so as to engage the dummy lift pin form during the pipe casting operation.

It is the intent of the spacer chair and dummy lift pin arrangement to provide a means of assuring the final position of the elliptical steel cage within the barrel of the pipe and, further, for providing a means of indexing the pipe in the field to assume proper placement of the pipe.

For pipe 114 inches or larger in diameter, the design information in accordance with Section 6 of ASTM Specification C76, shall be submitted to the ENGINEER OF RECORD for approval, prior to fabrication. The design of all pipes shall meet the D-load requirements for the class of pipe indicated on the Plans.

b. Reinforced concrete elliptical pipe shall conform to ASTM C507.

c. Precast Concrete Box Section

Precast concrete box sections shall meet the requirements of ASTM C789 or ASTM C850, as applicable.

d. Joints

See Paragraph 2.01.B.1.b. of this Section for requirements of premium joints for circular pipes 24 inches or less.

For circular pipe sizes 27 inches to 108 inches, the modified groove and bell ends of the pipe shall be smooth and shall not have over a 2-degree slope, formed to fit the rubber gasket to tolerances as determined by the manufacturer.

For circular pipe sizes under 36-inch diameter, the bell and tongue shall be reinforced. Where the reinforcing steel for the tongue, barrel and bell is not continuous, the steel shall be lapped a minimum of two (2) inches. Only lubricant, as supplied by the pipe manufacturer, shall be used on the groove and on the tongue in making up joints, and the joints shall be coupled in accordance with the pipe manufacturer's requirement.

See Paragraph 2.01.B.1.b. of this Section for requirements for a premium joint for non-circular concrete pipe.

The inside annular space of all concrete pipe 36-inch diameter and larger shall have the inside annular space filled with cement mortar and troweled flush. Mortar shall consist of 1-part Portland cement and two (2) parts of plaster sand. Mortar for inside joints shall be mixed with only enough water for dry packing.

B. Corrugated Metal Pipe

1. Corrugated Galvanized Steel Pipe

a. Pipe

Corrugated galvanized steel pipe with circular cross section and reformed corrugated galvanized steel pipe with pipe-arch shape shall conform to the requirements of AASHTO M36, and as specified in FDOT Sections 430 and 943. A minimum of two (2) circumferential corrugations shall be rolled on each end of each section of pipe.

b. Joints

The joints shall be made by use of coupling bands. The coupling bands shall be of the same material as specified for the pipe and shall prevent infiltration of the side fill material. Coupling bands fitting the configuration of the pipe to be jointed shall include two (2) O-ring neoprene gaskets for each joint.

2. Bituminous Coated Corrugated Steel Pipe

a. Pipe

Bituminous coated corrugated steel pipe with circular cross section and reformed corrugated steel pipe with pipe-arch shape shall conform to the requirements of AASHTO M36, AASHTO M190, Type C and as specified in FDOT Section 943-5. A minimum of two (2) circumferential corrugations shall be rolled on each end of each section.

b. Joints

See Paragraph 2.01.C.1.b. of this Section.

3. Epoxy-Bonded Corrugated Steel Pipe

a. Pipe

Epoxy-coated corrugated steel pipe with circular cross section and reformed corrugated steel pipe with pipe-arch shape shall conform to the requirements of AASHTO M36, AASHTO T241, AASHTO M218, and as specified in FDOT Sections 430 and 944. The pipe shall be of black steel with a minimum of two (2) circumferential corrugations rolled on each end of each section of pipe.

b. Joints

See Paragraph 2.01.C.1.b of this Section.

4. Aluminized Corrugated Steel Pipe

a. Pipe

Aluminized corrugated steel pipe with circular cross section and reformed corrugated steel pipe with pipe-arch shape shall conform to the requirements of AASHTO M36, AASHTO T241, AASHTO M218, AASHTO M274, Type 2 and as specified in FDOT Section 944. A minimum of two (2) circumferential corrugations shall be rolled on each end of each section.

b. Joints

See Paragraph 2.01.C.1.b. of this Section.

5. Corrugated Aluminum Pipe

a. Pipe

Corrugated aluminum alloy pipe with circular cross section and reformed corrugated aluminum alloy pipe with arch-pipe shall conform to the requirements of AASHTO M196 and as specified in FDOT Section 945.

b. Joints

See Paragraph 2.01.C.1.b. of this Section.

C. Polyethylene Pipe

1. Corrugated High Density Polyethylene Pipe

a. Pipe

Corrugated high density polyethylene pipe with circular cross section shall conform to the requirements of AASHTO M294 Type S. The pipe shall have a smooth interior and an annular-corrugated exterior, and manufactured with virgin polyethylene compounds.

b. Joints

The joints shall be bell and spigot, with the bell being an integral part of the pipe. The bell and spigot joint shall incorporate a manufacturer installed gasket.

c. Fittings

Fabricated fittings shall be welded on the interior and exterior at all junctions.

d. Material Properties

Pipe and fitting material shall be high density polyethylene conforming to the requirements of ASTM D3350 Cell Classification 324420C; or ASTM D Type III, Class C, Category 4, Grade P33.

D. Structural Plates for Field Assembly of Pipe, Pipe-Arches, and Arches

The plates, bolts and nuts to be used and field assembled circular pipe, pipe-arches and arches shall meet all applicable requirements of AASHTO. M167 and as specified in FDOT Sections 944 and 945.

E. End Sections

1. Precast Concrete End Section

a. The precast concrete end section shall conform to ASTM C76, Class II.

- b. The joint for connection to pipe shall be as specified in Section paragraph 2.01.B.1.b. of this Section.

2. Metal End Section

- a. Metal end sections shall conform to AASHTO M36.
- b. Joint

See Paragraph 2.01.C.1.b. of this Section.

3. Precast Concrete Ring

Precast concrete rings shall consist of a ring of concrete, of the dimensions shown on the Plans, cast around a section of the kind of pipe to be used in the culvert. Rings for concrete pipe culverts may be cast as a monolithic unit with the pipe.

F. Structures

Material for storm water structures shall conform to the requirements below and the details indicated on the Plan.

1. Clay Brick

Brick shall conform to ASTM C32, Grade MS, recessed or cored.

2. Concrete Brick

Brick shall conform to ASTM C139, Portland cement conforming to ASTM C150, Type II. Bricks shall be solid.

3. Precast Concrete Units

- a. Manhole Base and Riser Unit

Precast concrete manhole base and riser units shall conform to ASTM C478, and shall be circular with circular reinforcement. For manhole depths to 32 feet, the wall thickness of the sections shall be six (6) inches minimum. The joints on precast sections shall be the same as the joints on storm water conduits.

- b. Manhole Cone Unit

Precast concrete manhole cone units shall conform to ASTM C478. See paragraph 2.01.G.4.a. of this Section for joint requirements.

- c. Manhole Tees

Precast concrete manhole tee units shall conform to ASTM C76, Class IV and shall be circular with circular reinforcement. Shop Drawings shall be provided for all manhole tees.

See Paragraph 2.01.G.4.a. of this Section for joint requirements.

- d. Concrete Base

Precast concrete base unit shall conform to ASTM C478.

- e. Concrete Top Slab

Precast concrete top slab unit shall conform to ASTM C478.

f. Concrete Grade Rings

Concrete grade rings shall conform to ASTM C478. See paragraph 2.01.G.4.a of this Section for joint requirements.

g. Frames and Covers

Frames and covers for manholes, catch basins, and inlets shall conform to ASTM A48, Class 30, gray iron and shall be of the types and sizes as indicated on the Plans. The castings shall be neatly made and free from cracks, holes and other defects. Surfaces of casting shall be ground to assure proper fit and to prevent rocking.

G. Cast -In - Place Concrete

In accordance with FDOT Section 345, use Class II; 3,500-psi strength; Type I cement; 6.0 sacks cement per cubic yard; 5 coarse aggregate; silica sand fine aggregate; three (3) percent to six (6) percent air content; 3-inch maximum slump; no admixtures. without the ENGINEER OF RECORD,S approval.

1. Concrete Reinforcement

In accordance with FDOT Section 931, use ASTM A615, Grade 60 for bars and ASTM A185 for welded wire fabric.

2. Granular Material

Granular material shall be material passing a 1-inch sieve and at least 35% retained on a No. 200 sieve and meeting the approval of the ENGINEER OF RECORD.

PART 3 - EXECUTION

3.1 PREPARATION

A. Dewatering

During the preparation of the pipe bedding and until the trench has been satisfactorily backfilled, the trench shall be kept free of water. A dewatering system, in accordance with Section 02 14 00, Dewatering, shall be provided and maintained by the CONTRACTOR. The dewatering system shall remain in operation as directed by the ENGINEER OF RECORD.

B. Existing Storm Sewers and Drains

Expose the existing storm sewer and structures to which the new Work is to be connected. and notify the ENGINEER OF RECORD and OWNER of same. The ENGINEER OF RECORD will verify the vertical and horizontal locations of the existing system and shall inform the CONTRACTOR the necessary adjustments required to align the new storm sewer Work with the existing work.

C. Pipe Ends

The outside surface of the spigot end and the inside surface of the bell end of the pipe shall be cleaned and free of any foreign materials, other than the sealant recommended by the manufacturer, prior to installation.

D. Examination of Material

All pipe, frames, covers, accessories, and appurtenances shall be examined carefully for damage and other defects immediately prior to installation. Defective or damaged material shall be marked and held for inspection by the ENGINEER OF RECORD. Defective or damaged materials are subject to rejection by the ENGINEER OF RECORD.

3.2 PERFORMANCE

A. Excavation

Excavation shall be in accordance with Section 312300 for storm water conduits and all other storm water management structures.

B. CONTRACTOR's Verification - Excavation and Bedding

Prior to the installation of any storm sewer piping, structures, or materials, examine all trenches and other excavations for the proper grades, lines, levels and clearances required to receive the new Work. As certain that all excavation bottoms, compacted subgrades and pipe bedding are adequate to receive the storm sewer materials to be installed. Correct all defects and deficiencies before proceeding with the Work.

C. Installation

1. Pipe Bearing

Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length. Large stones and other hard matter that could damage piping or impede consistent backfilling or compaction shall be removed from the work area.

2. Pipe Cutting

Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square-cut end without damage to the pipe and that minimize air-borne particles shall be employed. Pipe cutting shall be performed using the recommendations of the manufacturer of the type of the pipe materials being cut and according to the best trade practices. When cutting pipe, care shall be taken to prevent damage to the interior and exterior surfaces. Damage to either shall be cause for rejection of a complete section of pipe.

3. Pipe Laying

Installation of pipe shall conform to ASTM C12, and as recommended by the pipe manufacturer.

The pipe shall be protected during handling against impact shocks and free fall. Hooks shall not be permitted to come in contact with premolded joint surfaces.

Pipes having premolded joint rings or attached couplings shall be handled so that no weight, including the weight of the pipe itself, will bear on or be supported by the jointing material. Care shall be taken to avoid dragging any pipe on the ground or allowing it to be damaged by contact with gravel, crushed stone, or other hard objects.

All pipe shall be laid to the line and grade called for on the Plans. Each pipe as laid shall be checked by the CONTRACTOR with line and grade pole or laser system to insure that this result is obtained. When employing a laser system, the CONTRACTOR shall have an independent and alternate means of checking the line and grade. The finished work shall be straight and shall be sighted through between manholes.

Construction shall begin at the outlet end and proceed upgrade with spigot ends pointing in direction of flow. Bell holes shall be excavated so that the full length of the barrel will bear uniformly on the subgrade.

Lubricants, primers or adhesives as recommended by the pipe or joint manufacturer shall be used immediately prior to jointing.

The pipe shall be centered in the bells or grooves and pushed tight together to form a smooth and continuous invert. After laying of pipe, care shall be taken so as not to disturb its line and grade. Any pipe found off grade or out of line shall be relaid properly by the CONTRACTOR.

Mechanical means shall be used for pulling home all pipe where manual means will not result in pushing and holding the pipe home. Mechanical means shall consist of a cable placed inside of the pipe with a suitable winch, jack, or come along for pulling the pipe home and holding the pipe in position.

Circular concrete pipe with elliptical reinforcement shall be installed with the lift holes to the top of the pipe. The manufacturer's marks designating the top and bottom of the pipe shall not be more than five (5) degrees from the vertical plane through the longitudinal axis of the pipe. After the pipe is installed, the lift holes shall be sealed with suitable concrete plugs.

Type HE elliptical pipe shall be installed with the longer axis placed horizontally within a tolerance of $\pm$ five (5) degrees.

Type VE elliptical pipe shall be installed with the longer axis placed vertically within a tolerance of $\pm$ five (5) degrees.

4. Pipe Bedding and Cover

Pipe bedding shall conform to ASTM C12, except as noted.

Class A

The pipe shall be bedded in crushed stone bedding material placed on the trench bottom. The bedding material shall have 100% passing a 3/4 inch sieve and 95% retained on a No. 4 sieve. The bedding shall have a minimum thickness beneath the pipe of four (4) inches or 1/4 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline. The top half of the pipe shall be covered with a monolithic plain concrete arch having a thickness of at least four (4) inches or 1/4 of the inside diameter of the pipe, whichever is greater, at the pipe crown and a minimum width equal to the outside diameter of the pipe plus eight (8) inches or 1-1/4 of the diameter of the pipe, whichever is greater.

Class B

The pipe shall be bedded in crushed stone bedding material placed on the trench bottom. The bedding material shall have 100% passing a 3/4 inch sieve and 95% retained on a No. 4 sieve. The bedding shall have a minimum thickness beneath the pipe of four (4) inches or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline. Backfill from pipe horizontal centerline to a level not less than 12 inches above the top of the pipe shall be natural bank run sand meeting the requirements of granular material, and approved by the ENGINEER OF RECORD. This material shall be placed in 6-inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.

Class C

The pipe shall be bedded in natural bank run sand, approved by the ENGINEER OF RECORD, meeting the requirements of granular material, placed on the trench bottom. The bedding shall have a minimum thickness beneath the pipe of four (4) inches or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches above the top of the pipe. This material shall be placed in 6-inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.

Continuous and uniform bedding shall be provided in the trench for all buried pipe. Materials damaged by backfill compaction are subject to rejection by the ENGINEER OF RECORD.

5. Structures

Construct storm water manholes, catch basins, inlets and structures to the grades, lines and levels indicated on the Drawings and as specified. Structures shall be complete with concrete bases, reinforcing, frames, covers, adjustment bricks, etc. as shown and as required for a complete installation. Storm sewer structures shall conform to the dimensions indicated on the Plans. Materials damaged by backfill compaction are subject to rejection by the Owners

Representative.

Brick

Prior to laying, all brick shall be thoroughly wetted and the surfaces allowed to dry only sufficiently to prevent slippage on the mortar.

Broken or chipped brick shall not be used on the face of the structure.

Brick shall be laid in neat, even consecutive courses with full and close mortar joints. Courses shall be level throughout, except as shown or otherwise required. Stagger joints in adjoining courses by 2 a brick as nearly as practicable. Length of brick closure pieces shall be not less than the width of one (1) whole brick and, wherever practicable, shall be made from whole brick.

Unless otherwise indicated, joints shall be not more than 2-inch thick and shall be of a uniform thickness throughout the structure. Joints shall be provided as indicated on the Plans. Exposed surfaces shall be true and smooth. Rake all joints to receive plaster coat.

Prior to applying plaster coat, brick shall be thoroughly wetted with water and the surface allowed to dry sufficiently to effect proper bonding.

Precast Concrete Units

Construct as detailed on the Plans. Provide mortar joints struck smooth. Provide three (3) to five (5) courses of 8-inch brick or concrete grade rings at top of structure for future adjustment of castings.

Plaster Coat

A cement mortar plaster coat shall be applied to the exterior surfaces of the brick and block sections of all storm structures as indicated on the Plans. Plaster coat shall be 2-inch thick.

Castings

Provide and install to the elevations indicated on the Plans, all cast iron covers, and frames, as required. Castings shall be set in a full bed of cement mortar 2 inch thick, minimum. Mortar joints shall be struck smooth.

Inlet and Outlet Pipe

Pipes to 42 inches in diameter, shall be connected to storm structures using a grouted joint, as indicated on the Plans. The pipe shall be properly supported, so that any settlement will not disturb the connection.

For pipe, 48 inches in diameter or larger, the pipe shall be installed as an integral part of the manhole which shall be constructed of 3,500 psi concrete and reinforcing, as indicated on the Plans.

Manhole tees, as indicated on the Plans, may be used for pipe 42 inches in diameter or larger. Connection to manhole tees shall be made using tees and pipe having the same type of joint. The pipe and tee shall be properly supported with concrete as indicated on the Plans.

Flow Channels

Flow channels shall be constructed in all structures not requiring a sump and shall be constructed as indicated on the Plans.

Backfilling

Backfilling operations shall be in accordance with Section 312300 above storm water conduit and for all other structures.

3.3 Field Quality Control

A. General

After all the pipe and structures have been laid, constructed and backfilled, the system shall be final inspected. The storm water system shall be ready for the final inspection within two (2) weeks after the completion of the final backfill operation.

The final inspection shall consist of a visible and audible check of the conduits and structures to ascertain that the steps have been placed, all lift holes jointed, the channeling of the manhole bottoms as specified on the plans completed, all visible or audible leaks stopped, all conduits have been placed straight and true to the proper slopes and elevations, the required brick courses for adjustment, the frame and cover properly installed, the required end section installed, all trenches and structures backfilled in a workmanlike manner and that the system has been thoroughly cleaned.

The final inspection shall be considered complete when all the repairs have been made.

B. Construction Tolerances

1. Maximum variation from intended slope gradient of conduit run between structures or termination at an end section: constructed conduit gradient must slope in intended direction and support a self cleaning velocity of 2.0 feet per second assuming free outfall and without significantly compromising design flood conditions approved by permit.
2. Maximum offset of conduit from true horizontal alignment: 1-inch.
3. Maximum variation in profile of structure from intended position: ½ inch.

END OF SECTION

APPENDIX ONE

Report of Geotechnical Exploration, dated September 9, 2022
(AREHNA, Project No. B-22-116)



REPORT OF GEOTECHNICAL EXPLORATION

THONOTOSASSA FIRE STATION 21 THONOTOSASSA, FLORIDA

AREHNA PROJECT NO. B-22-116
SEPTEMBER 9, 2022

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September 9, 2022

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Subject: **Report of Geotechnical Exploration**
Thonotosassa Fire Station 21
Northeast Corner of Mango Road and Main Street
Thonotosassa, Florida 33592
AREHNA Project B-22-116

AREHNA Engineering, Inc. (AREHNA) is pleased to submit this report of our geotechnical exploration for the proposed project. Services were conducted in general accordance with AREHNA Proposal B.Prop-22-141, submitted June 29, 2022. The purpose of our geotechnical study was to obtain information on the general subsurface conditions for the project site. The project consists of a new fire station with associated pavement and stormwater areas. AREHNA previously completed a preliminary investigation at this site (Project B-17-077, report date of August 18, 2017) for Campo Engineering. The data from the previous investigation is combined with the current data for this report.

This report presents our understanding of the project, outlines our exploratory procedures, documents the field data obtained and includes our recommendations for the proposed constructions.

AREHNA appreciates the opportunity to have assisted Wilder Architecture on this project. Should you have any questions with regards to this report, or if we can be of any further assistance, please contact this office.

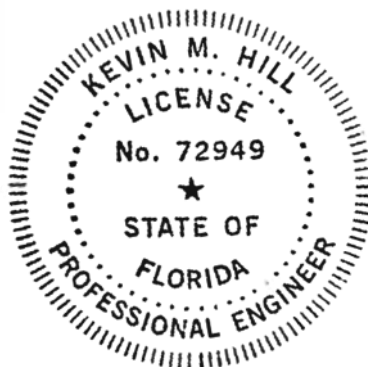
Best Regards,
AREHNA ENGINEERING, INC.

FLORIDA BOARD OF PROFESSIONAL ENGINEERS CERTIFICATE OF AUTHORIZATION No. 28410

This item has been digitally signed and sealed by:



Gordon Appleton, E.I.
Engineer Intern



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On the date adjacent to the seal.
Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies

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1.0 PROJECT INFORMATION AND SCOPE OF WORK

1.1 SITE DESCRIPTION AND PROJECT CHARACTERISTICS

The project site is located northeast of the intersection of Mango Road and Main Street in Thonotosassa, Florida. The existing site is undeveloped and mostly wooded. The project consists of a new fire station, with associated pavement and stormwater areas. AREHNA previously completed a preliminary investigation of this site (AREHNA Project B-17-077, report date of August 18, 2017) for Campo Engineering. The data from the previous investigation is combined with the current data for this report.

1.2 SCOPE OF WORK

The purpose of our geotechnical study was to obtain information on the general subsurface conditions at the proposed project site. The subsurface materials encountered were evaluated with respect to the available project characteristics. In this regard, engineering assessments for the following items were formulated:

- Identification of the existing groundwater levels and estimated normal seasonal high groundwater fluctuations.
- General location and description of potentially deleterious materials encountered in the borings which may have an impact on the proposed construction.
- Allowable capacities and estimated foundation settlement for shallow foundation supporting the structure.
- General geotechnical recommendations for the proposed construction.
- Infiltration rates based on double-ring infiltration tests.

The following services were performed to achieve the above-outlined objectives:

- Reviewed data from our previous investigation at this site.
- Requested utility location services from Sunshine811.
- Performed a total of five (5) Standard Penetration Test (SPT) borings to depths of 15 to 25 feet at the project site.
- Performed a total of eight (8) Hand Auger borings to depths of 6 feet at the project site.
- Performed two (2) Double Ring Infiltration (DRI) tests at approximately 2 feet below the existing ground level.
- Visually classified, lab tested and stratified soil samples in the laboratory using the Unified Soil Classification System (USCS).
- Reported the results of the field exploration and engineering analysis. The results of the subsurface exploration are presented in this report, signed, and sealed by a professional engineer specializing in geotechnical engineering.



2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 FIELD EXPLORATION

Prior to drilling, limited clearing was completed to create accessibility paths for our drill rig. Three (3) SPT borings were completed to depths of 25 feet below the existing ground surface; two (2) SPT borings were completed to a depth of 15 feet below the existing ground surface. Eight (8) Hand Augers were performed to a depth of 6 feet below the existing ground surface. Two (2) Double Ring Infiltration (DRI) Tests were performed at a depth of 2 feet at this site. Boring and test locations were provided by the client. The 25-foot-deep borings (SPT-01, SPT-02, and SPT-03) were placed at proposed structure locations; the 15-foot-deep SPT borings (SPT-04 and SPT-05) were placed within the proposed stormwater locations. The DRI Tests were placed alongside the 15-foot SPT borings in the proposed stormwater locations.

The SPT borings were performed with the use of a Power Drill Rig using Bentonite "Mud" drilling procedures. Samples were collected and Standard Penetration Test resistances were measured continuously for the top ten feet and at approximate intervals of five feet thereafter. The soil sampling was performed in general accordance with ASTM Test Designation D-1586, entitled "Penetration Test and Split-Barrel Sampling of Soils." Representative portions of the samples collected were sealed in glass jars, labeled, and transferred for appropriate classification. Samples will be retained for 90 days after the date of the report and then disposed, unless other arrangements have been made.

The hand auger borings were performed by manually advancing a 3-inch diameter, 6-inch-long sampler into the soil until the sampler was full. The sampler was then retrieved and the soils in the sampler were removed and visually classified. The soil sampling was performed in general accordance with ASTM Test Designation D-1452, entitled "Soil Investigation and Sampling by Auger Borings." Hand auger boring depths were limited by the shallow water table.

The DRI tests were performed by installing a 12-inch diameter inner steel ring and a 24-inch diameter outer steel ring concentrically into the ground to the desired test depth. Water was then added to a desired level in both rings and held constant. The amount of water added to the inner ring versus time was then recorded. This procedure was repeated every 15 minutes for a total of 1.5 to 4 hours or until a stabilized infiltration rate was achieved. The DRI tests were performed in general accordance with ASTM D-3385, entitled "Standard Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometer." A discussion of the Double Ring Infiltration test results is provided in **Section 3.4** and DRI test result details are provided in **Appendix B**.

The **Boring Location Plan** on **Sheet 2** in **Appendix A** provides a boring location site plan showing the approximate relationship of existing and proposed features to the test locations. Previously completed borings are also shown on this sheet. The test locations were located in the field using GPS coordinates and a hand-held GPS unit and should be considered approximate.



2.2 LABORATORY TESTING

Laboratory testing, consisting of natural moisture content and single sieve (#200) gradation testing were performed on representative soil samples from the SPT borings. The results of the laboratory testing are presented on the **Soil Boring Profiles** on **Sheets 3A through 3E** in **Appendix A** and are summarized on **Table 1** in **Appendix B**.



3.0 SUBSURFACE CONDITIONS

3.1 USGS TOPOGRAPHIC DATA

The topographic survey map published by the United States Geological Survey was reviewed for ground surface features at the proposed project location (**Sheet 1** in **Appendix A**). AREHNA was also provided with a previous site survey of the property. Based on our review of the survey, the natural ground surface elevations at the project site are mostly between +39 to +42 feet National American Vertical Datum of 1988 (NAVD 88). The lowest elevations were at the northern portion of the property and the highest elevations were at the southern portion of the property. Elevations referenced in this report should be considered approximate only.

3.2 USDA NATURAL RESOURCES CONSERVATION SERVICE DATA

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) survey for Hillsborough County indicates that the soils at the project site consist of the following soil units:

Table 3.2 Summary of USDA Soil Survey		
Soil Unit Number	Soil Name	Depth Below Natural Grade to High Water Table (feet)
7	Candler fine sand, 0 to 5 percent slopes	>6.5
53	Tavares-Millhopper fine sand, 0 to 5 percent slopes	3.5 - 6

Soil Map Unit 7 covers most of the site. Soil Map Unit 53 is present along the north end of the site, encroaching partially into the northern stormwater area.

3.3 SUBSURFACE CONDITIONS

A pictorial representation of the subsurface conditions encountered in the borings is shown on the Soil Boring Profiles in **Sheets 3A** through **3E** in **Appendix A**. These profiles and the following soil conditions highlight the general subsurface stratification. When reviewing the boring records and the subsurface soil profiles, it should be understood that soil conditions may vary between, and away from, boring locations.

Variable soil conditions were encountered in the soil borings. The following is a brief description of the soils for each boring based on the proposed features in those areas:

Structure

Boring SPT-01 contains very loose to medium dense sand (SP) from the ground surface to the depth of approximately 12 feet below ground surface (bgs). This was followed by medium dense slightly clayey sand



(SP-SC) at a depth of approximately 12 feet bgs to about 22 feet bgs. This was followed by a layer of stiff clayey sand (SC) at a depth of 22 feet bgs to the termination depth of 25 feet bgs.

Boring SPT-02 contains very loose to medium dense sand (SP) from the ground surface to the depth of approximately 12 feet below ground surface (bgs). This was followed by a layer of dense clayey sand (SC) from the depth of 12 feet bgs to 22 feet bgs followed by a layer of medium dense slightly clayey sand (SP-SC) from the depth of 22 feet bgs to the termination depth of 25 feet bgs.

Boring SPT-03 contains loose sand (SP) from the ground surface to the depth of approximately 6 feet bgs. This is followed by a layer of loose to dense clayey sand (SC) from a depth of 6 feet bgs to approximately 17 feet bgs followed by a layer of clayey sand (SP-SC) from a depth of 17 feet bgs to the termination depth of 25 feet bgs.

Stormwater Areas

Borings SPT-04 and SPT-05 were composed of loose to medium dense fine sands (SP, SP-SM) from the ground surface to depths of 12 to 15 feet bgs. Boring SPT-04 contained medium dense clayey sand from depths of 12 feet bgs to the termination depth of 15 feet bgs.

Pavement Areas

All of the hand auger borings were composed of sand to slightly silty sand (SP, SP-SM) from the ground surface to the termination depth of 6 feet bgs.

3.4 DOUBLE RING INFILTRATION TEST RESULTS

The following table summarizes the Double Ring Infiltration (DRI) test results:

Table 3.5 Double Ring Infiltration Test Results			
Test Location	Depth Below Ground Surface, feet	Measured Mean Permeability Rate, k_m (inch/hour)	Measured Mean Permeability Rate, k_m (cm/sec)
DRI-01	2.0	40	2.8E-2
DRI-02	2.0	15.1	1.1E-2
DRI-03	2.0	22.3	1.6E-2

For design purposes, we do not recommend using a permeability rate above 25 in/hr (50 ft/day). We do recommend using the same value for both vertical and horizontal permeability rates at this site. The measured rates above are ultimate rates without Safety Factor. Proper Safety Factors should be used in stormwater design to account for variability in the soil and other factors.



3.5 GROUNDWATER CONDITIONS

The groundwater was undiscernible for all SPT borings. Fluctuation in ground water levels should be expected due to seasonal climatic changes, construction activity, rainfall variations, surface water runoff, and other site-specific factors.

3.6 ESTIMATED SEASONAL HIGH GROUNDWATER LEVEL

We did not encounter the water table within the surficial 10 feet of SPT borings or within the depth of exploration of the hand auger borings (6 feet). Most of the site is reported to be Candler sand, which has a deep water table. The north end of the site is at a slightly lower elevation and the Soil Survey reports the water table may be shallower there. Based on the data collected and provided ground surface elevations, we recommend a design water table at approximately elevation +32 feet. If a more precise water table elevation is needed, we recommend installation of a piezometer and recording water levels throughout the wet season.

Rainwater will also tend to temporarily perch on top of the clayey sand layer that was present in a few of the soil borings at depths ranging from 6 feet (SPT-03) to more than 10 feet. Water table depths will vary across the site due to variations in the ground surface elevation as the site is slightly sloping.



4.0 DESIGN RECOMMENDATIONS

4.1 GENERAL

Our geotechnical evaluation is based upon the previously presented project information as well as the field data obtained during this geotechnical exploration. If the final structure location or foundation loads are significantly different from those described or if the subsurface conditions during construction are different from those revealed by our borings, we should be notified immediately so that we might review our recommendations presented in this report.

In general, the site is suitable for structures with shallow foundations, pavement and dry stormwater ponds. The soils are very sandy and the water table is relatively deep. No deleterious soil conditions were encountered in the borings. The shallow soils are very loose to loose sands. Compaction beneath foundations and slabs-on-grade will be important for foundation performance.

The site is generally undeveloped. After stripping to remove vegetation, near-surface debris, root systems, and other deleterious materials, the site should be compacted and proofrolled. Any areas that appear unstable under proofrolling should be replaced with compacted fill. Our recommended site preparation is presented in **Section 5.0, General Site Preparation**.

4.2 SHALLOW FOUNDATION DESIGN

Following our recommended General Site Preparations, the proposed structures can be constructed on a system of conventional shallow spread or strip footings. The foundation systems may bear on suitable compacted existing soils or compacted structural fill soils. Shallow foundations may be designed using an allowable net soil bearing pressure of 2,000 psf with a minimum foundation embedment of 12-inches below final grade. Our bearing capacity evaluation was based on correlations between N-values and the successful performance of similar structures on similar soil conditions.

All footings should be embedded so that the bottom of the foundation is a minimum of 12 inches below the adjacent compacted grades on all sides. Strip or wall footings should be a minimum of 18 inches wide and pad or column footings should be a minimum of 30 inches wide. These minimum footing sizes should be used regardless of whether the maximum allowable bearing pressures are fully developed in all loading conditions. All footings should be embedded so that the bottom of the foundation is a minimum of 12 inches below the adjacent final grades on all sides. These minimum footing sizes tend to provide adequate load bearing area to develop overall bearing capacity and account for minor variations in the bearing materials.

4.3 FLOOR SLAB DESIGN

The floor slab (or any slabs-on-grade) may be supported on suitable compacted existing soils or compacted structural fill. The slab subgrade soils should be compacted to a minimum dry density of at least 98 percent of



the Modified Proctor maximum dry density to a depth of at least 12 inches. The floor slab should be appropriately jointed to control the location of shrinkage cracking.

Based upon the shallow soil conditions encountered at the site, the planned fill placement, and the recommended site preparation operations presented in this report, the modulus of vertical subgrade reaction (k) for the slab bearing soils is expected to be on the order of 150 pounds per square inch per inch of vertical deflection (pci), at the recommended structural fill compaction criteria. Our evaluation was based on satisfactory performance of our recommended approach with other structures and similar soil conditions.

4.4 SETTLEMENT

Approximately 80% to 90% of the settlement of shallow foundations supported on sandy soils should occur rapidly during construction as dead loads are imposed at the footing locations. Some slight long-term settlement may occur over the first few weeks after construction is completed where clayey sand is present in the subsurface, but this long-term settlement should be very minor. Provided that the recommended subsurface preparation operations are properly performed, the total settlements of isolated column and wall footings should be less than 1 inch (on the order of about ½-inch), with differential settlements on the order of 50 percent of the total settlements.

4.5 PAVEMENTS

We have not been provided with design traffic loading, but heavy fire trucks will use this site. In our experience, the following minimum recommended pavement sections should work successfully for similar sites, so they are suggested for this construction.

The following recommendations for new pavement assume an adequately drained pavement subgrade and at least (absolute minimum) 12 inches of separation between the groundwater level and crushed concrete base, or at least 18 inches of separation between the groundwater level and limerock base. The water table is deep enough to allow limerock to be used as a base material at for any flexible pavements.



Table 4.5 Typical (Minimum) Pavement Section		
Pavement Section	Component	Recommended Thickness (in.)
Standard Duty Flexible Pavement Section	Asphalt	1.5
	Base (LBR $\geq$ 100)	6.0
	Stabilized Subgrade (LBR $\geq$ 40)	6.0
Heavy Duty Flexible Pavement Section	Asphalt	2.0
	Base (LBR $\geq$ 100)	8.0
	Stabilized Subgrade (LBR $\geq$ 40)	12.0
Standard Duty Rigid Pavement Section	Concrete	5.0
	Subgrade (clean sand or gravel)	12.0
Heavy Duty Rigid Pavement Section	Concrete	6.0
	Subgrade (clean sand or gravel)	12.0

Subgrade: Sandy existing soils and sandy structural fill soils should be acceptable for construction and support of a flexible pavement section after proper compaction, subsurface preparation and proofrolling. Alternatively, a rigid concrete section may be used.

Fill soils, if needed, should consist of reasonably clean fine sands (inorganic, non-plastic sands containing less than 12 percent material passing the No. 200 mesh sieve). For flexible pavements, we recommend that any fill, if needed, below the stabilized subgrade be compacted to at least 95 percent of the Modified Proctor maximum dry density (ASTM D-1557). The upper foot of pavement subgrade should be compacted to 98% ASTM D1557. Traffic should not be allowed on the subgrade before the base is placed to avoid rutting.

Base: For flexible pavements, we recommend that the base layer be at least 6 inches thick for parking lots or other light duty areas and at least 8 inches thick for main drive or other heavy-duty areas. Base materials should meet Florida Department of Transportation (FDOT) Standard Specification, Section 200 requirements (or governing County/City Specifications), including compaction to 98 percent of its maximum dry density as determined by the Modified Proctor Test (ASTM D-1557) and a minimum Limerock Bearing Ratio (LBR) of 100. Crushed concrete should have an LBR value of 150 and be graded in accordance with Florida Department of Transportation (FDOT) Standard Specifications Section 204, or governing County/City Specifications.

A No. 57 washed stone (or other gravel with low fines) may be used as a base beneath any rigid concrete pavement sections; however, clean sand (SP) may also be used as a base for rigid pavement. It is important that the upper 12 inches of material directly below rigid pavement is free-draining (low fines) material.

Asphaltic Concrete: The asphaltic concrete structural course should consist of Type SP asphaltic concrete material. A minimum asphalt thickness of 1.5 inches should be used in areas of light duty applications. The asphaltic concrete should meet standard FDOT material requirements and placement procedures as outlined in the most recent edition of the FDOT Standard Specifications for Road and Bridge Construction, or governing County/City Specifications.



Portland Cement Concrete:

For rigid pavement, we suggest that concrete with an unconfined compressive strength of at least 4,000 lb/in² be placed over properly compacted subgrade soils. It is recommended that a minimum thickness of 5 inches be utilized in areas of light duty applications, and a minimum of a 6-inch thickness for areas with moderate to heavy duty (truck paths) applications. The upper 12 inches of subgrade directly below any rigid pavement should be free draining material (clean sand or fine open graded gravel).

The key to a successful rigid pavement is properly spaced control joints, a good concrete mix, and proper workmanship. We recommend a maximum longitudinal to transverse pattern ratio of 1.2 to 1. We further recommend that the jointed section area ideally be on the order of 250 square feet but no more than 400 square feet. Joints that intersect the edge should do so perpendicular to the edge. The joints should have a minimum cut depth of at least 1 inch or 1/5 of the slab thickness, whichever is greater. The joints should be cut within 8 hours of concrete placement. The requirements of FDOT Standard Specification Section 346, or governing County/City Specification, should also be met as appropriate. It is suggested that a rigid pavement be utilized in dumpster areas, including the areas in which dumpster trucks or other large vehicles load, backup and turn around.

4.6 STORMWATER AREAS

The water table depth varies based on ground surface elevation but is at least 6 to possibly 10 or more feet below the existing ground surface depending on the location. As stated in Section 3.6, we recommend a design water table at approximately elevation +32 feet which should allow for dry pond design and excavation of sandy soil for re-use as structural fill.

Infiltration (DRI) tests at a depth of 2 feet across the northern portion of the site, where the stormwater pond is proposed, provided infiltration rates ranging from about 15 to 40 in/hr (30 to 80 ft/day). For design purposes, we recommend limiting the infiltration rate to no more than 25 in/hr (50 ft/day). Additionally, a safety factor should be applied to the design rate to account for soil variability and other factors.

There was not a consistent confining layer in the subsurface, but boring SPT-04 encountered a clayey sand (SC) layer beginning at about 12 feet below the existing ground surface. If needed for design, we recommend a design confining layer at 12 feet depth. Also, if needed for design, we recommend a fillable porosity of 30% for the shallow sandy soil.



5.0 GENERAL SITE PREPARATION

5.1 ON-SITE SOIL SUITABILITY

Below the topsoil, sandy shallow soils present at the site classified as sand (SP), slightly silty sand (SP-SM) in the upper 6 to more than 10 feet are generally suitable for re-use as structural fill (or pavement embankment). Clayey sand (SC), if encountered in excavations, is not suitable for re-use and should be discarded.

Soil excavated from below the groundwater level will be above the optimum moisture content required for compaction and will need to be dried before placement. Suitable structural fill materials should consist of fine to medium sand with less than 12 percent passing the No. 200 sieve and be free of rubble, organics, clay, debris and other unsuitable material. Any off-site materials used as fill should be approved by AREHNA prior to acquisition.

5.2 EARTHWORK

The initial step in site preparation should be the complete removal of all vegetation, topsoil, root systems, existing foundations or pavement, and other deleterious materials from beneath and to a minimum of five feet beyond the development perimeter (within the property limits). Since this site is wooded, it is important that entire stumps and primary root systems are fully removed prior to grading and compacting. Also, prior to construction, the location of any existing underground irrigation, septic tanks, drainage, or other utility lines within the construction area should be established. In this regard it should be noted that if abandoned underground pipes are not properly removed or plugged, they may serve as conduits for subsurface erosion which subsequently may result in excessive settlements. The project areas should then be inspected and thoroughly compacted and proofrolled as directed by a Geotechnical Engineer. Our recommendations listed in this section should be used as a guideline for the project general specifications prepared by the Design Engineer:

- The entire site should be compacted with a large vibratory roller with a 4-foot diameter drum and a static weight of at least 10 tons. At least 8 complete coverages (4 in each perpendicular direction) should be performed over the entire building and pavement areas prior to raising site grades. Compaction should continue for the required number of passes and until the soil at a depth of 12 inches below the compaction surface has attained a minimum of 95 percent of the Modified Proctor maximum dry density (ASTM D-1557). Careful observations should be made during proofrolling to help identify any areas of soft-yielding soils that may require over excavation and replacement.
- Following satisfactory completion of proofrolling, additional fill, if needed, can be placed and compacted as needed to achieve the desired grades. Fill should generally consist of dry fine sand with less than 12 percent passing the No. 200 sieve, free of



- rubble, organics, clay, debris and other unsuitable material. Fill should be tested and approved prior to acquisition.
- Approved sand fill should be placed in loose lifts not exceeding 12 inches in thickness and should be compacted to a minimum of 95 percent of the Modified Proctor maximum dry density (ASTM D-1557). The upper foot of pavement subgrade and pavement base materials should be compacted to at least 98 percent of Modified Proctor. Density tests to confirm compaction should be performed in each fill lift before the next lift is placed.
 - Prior to beginning compaction, soil moisture contents should be adjusted in order to facilitate proper compaction. A moisture content within 2 percentage points of the optimum indicated by the Modified Proctor Test (ASTM D-1557) is recommended prior to compaction of the natural ground and fill.
 - Immediately prior to reinforcing steel placement, it is suggested that the bearing surfaces of all footing and slabs-on-grade locations be compacted using hand-operated mechanical tampers. In this manner, any localized areas which have been loosened by excavation operations should be adequately re-compacted.
 - A materials testing laboratory should be retained to provide on-site observation of earthwork and ground modification activities. Density tests should be performed in the top one foot of compacted existing ground, in each fill lift, and at the bottom of foundation or slab excavations.



6.0 BASIS FOR RECOMMENDATIONS

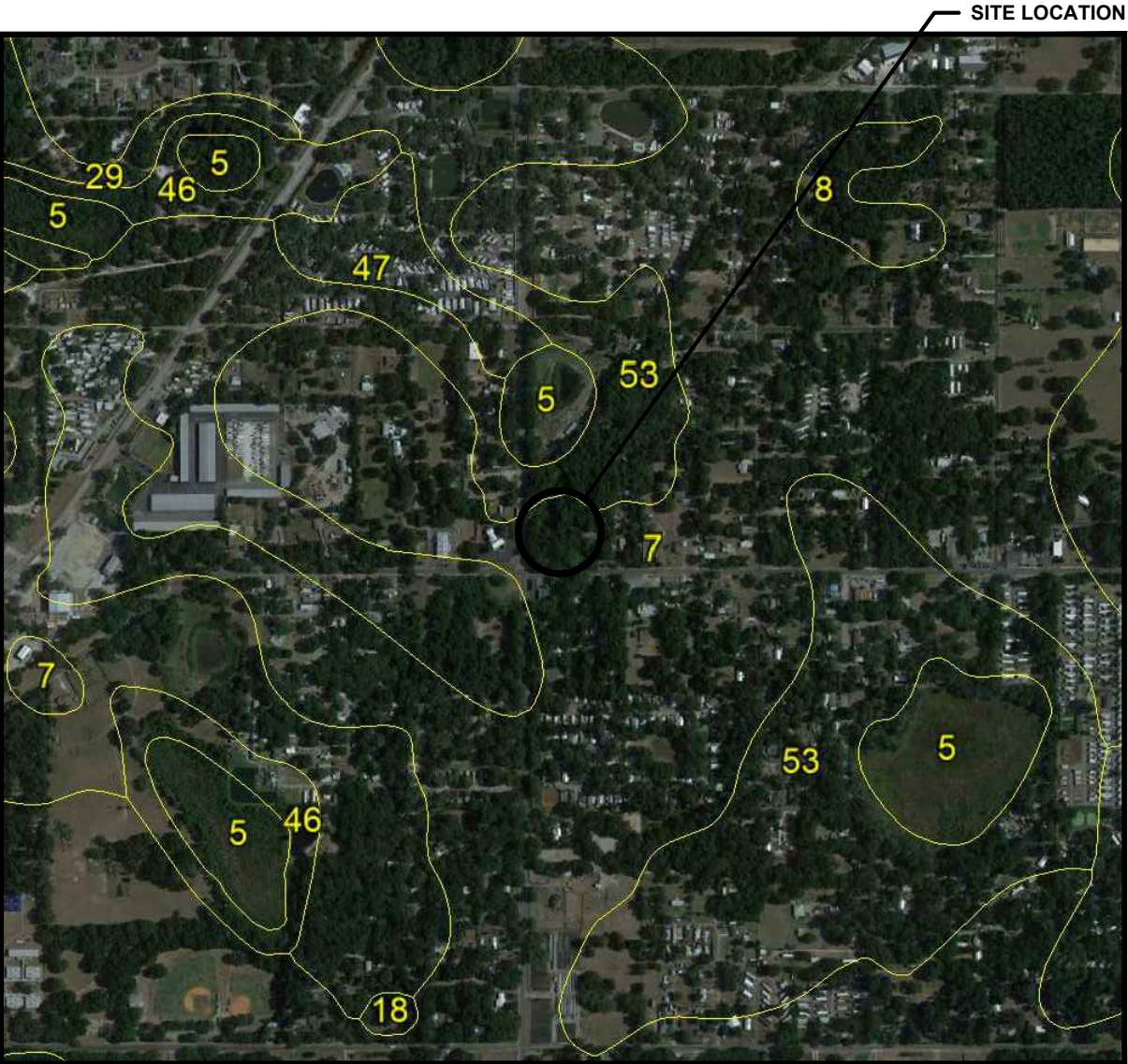
The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings performed at the locations indicated. Regardless of the thoroughness of a geotechnical exploration, there is always a possibility that conditions at other locations will be different from those at the specific boring locations and that conditions will not be as anticipated by the designers or contractors. In addition, the construction process itself may alter soil conditions. AREHNA is not responsible for the conclusions, opinions or recommendations made by others based on the data presented in this report.



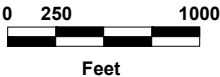
APPENDIX A

USDA & USGS Vicinity Maps – Sheet 1
Boring Location Plan - Sheet 2
Soil Boring Profiles – Sheet 3A to 3E

USDA SOIL SURVEY MAP

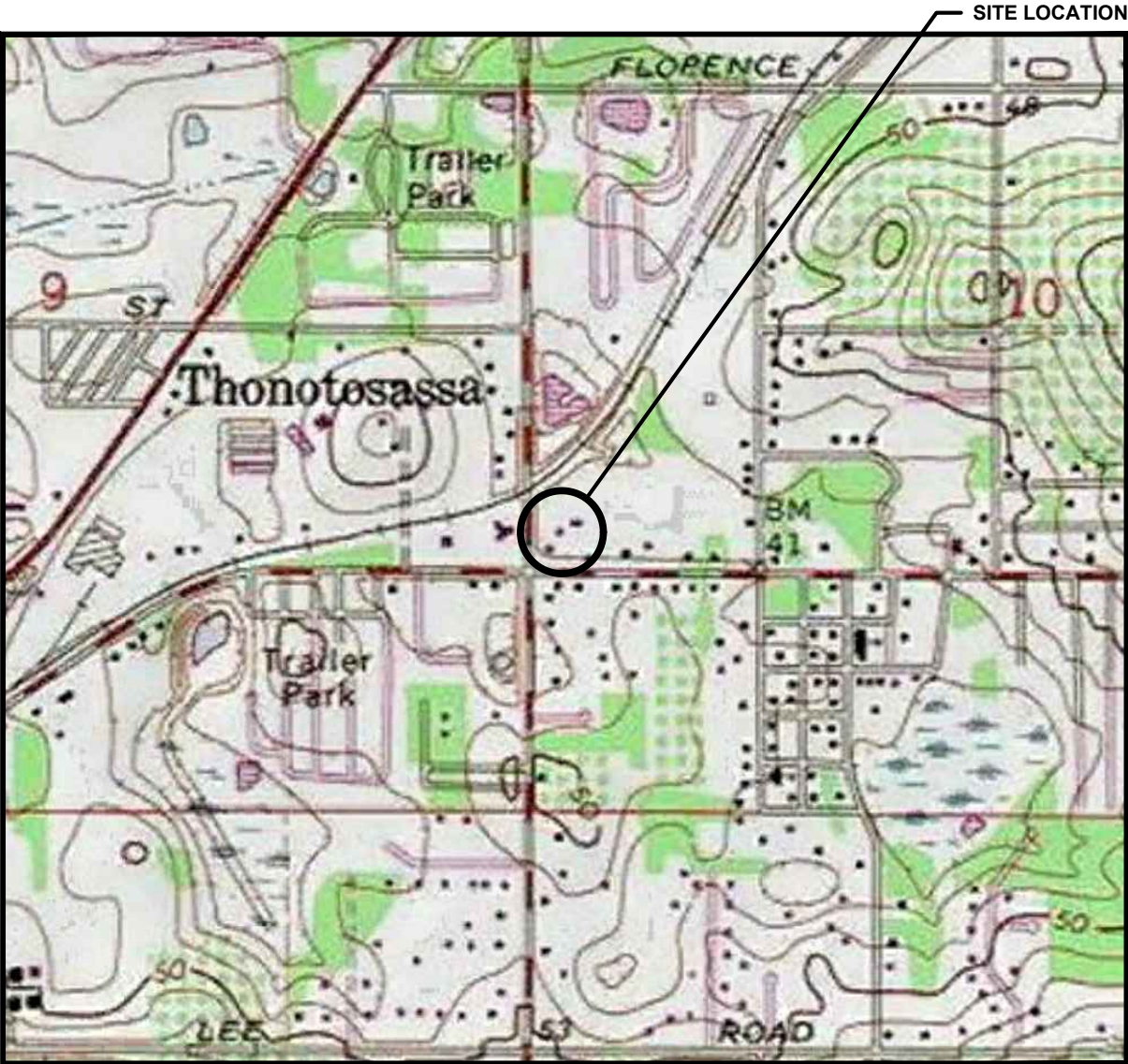


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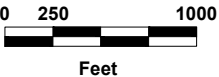


TOWNSHIP: 28 S
RANGE: 20 E
SECTION: 10

USGS TOPOGRAPHIC MAP

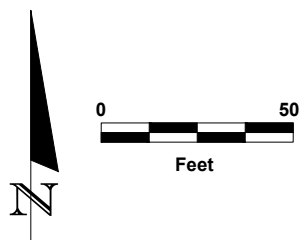


REFERENCE: "THONOTOSASSA, FLORIDA" USGS QUADRANGLE MAP



TOWNSHIP: 28 S
RANGE: 20 E
SECTION: 10

REVISIONS				PREPARED BY:  AREHNA Engineering, Inc. 5012 West Lemon Street, Tampa, FL 33609 Phone 813.944.3464 Fax 813.944.4959 Certificate of Authorization No. 28410	USDA & USGS VICINITY MAPS	NAME			DATE	PROJECT NAME		PROJECT NO.	SHEET NO.
NO.	DATE	DESCRIPTIONS				APPROVED	DESIGNED BY:	GA	8/2022	THONOTOSASSA FIRE STATION 21 THONOTOSASSA, FLORIDA	B-22-116	1	
							DRAWN BY:	DG	8/2022				
							CHECKED BY:	KH	8/2022				
							SUPERVISED BY:		Kevin M. Hill, P.E.				



LEGEND

- APPROXIMATE LOCATION OF SPT BORING
- APPROXIMATE LOCATION OF AUGER BORING
- APPROXIMATE LOCATION OF DOUBLE RING INFILTRATION TEST
- APPROXIMATE LOCATION OF AUGER BORING (PERFORMED 2017)
- APPROXIMATE LOCATION OF DOUBLE RING INFILTRATION TEST (PERFORMED 2017)

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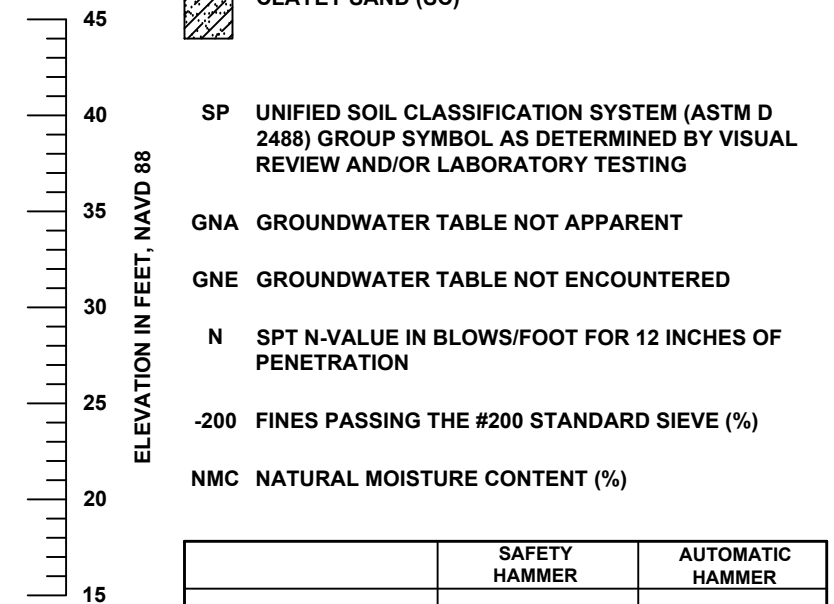
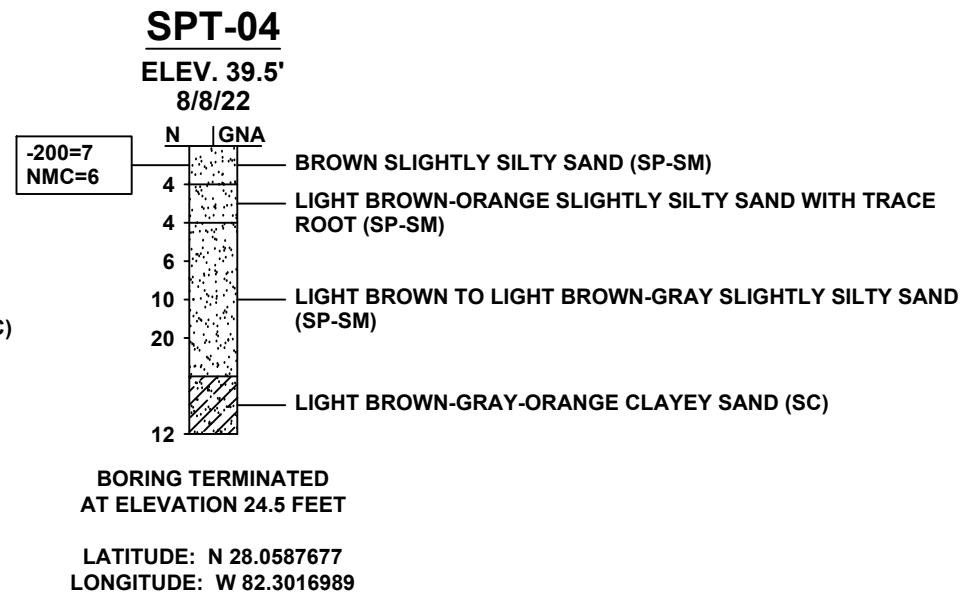
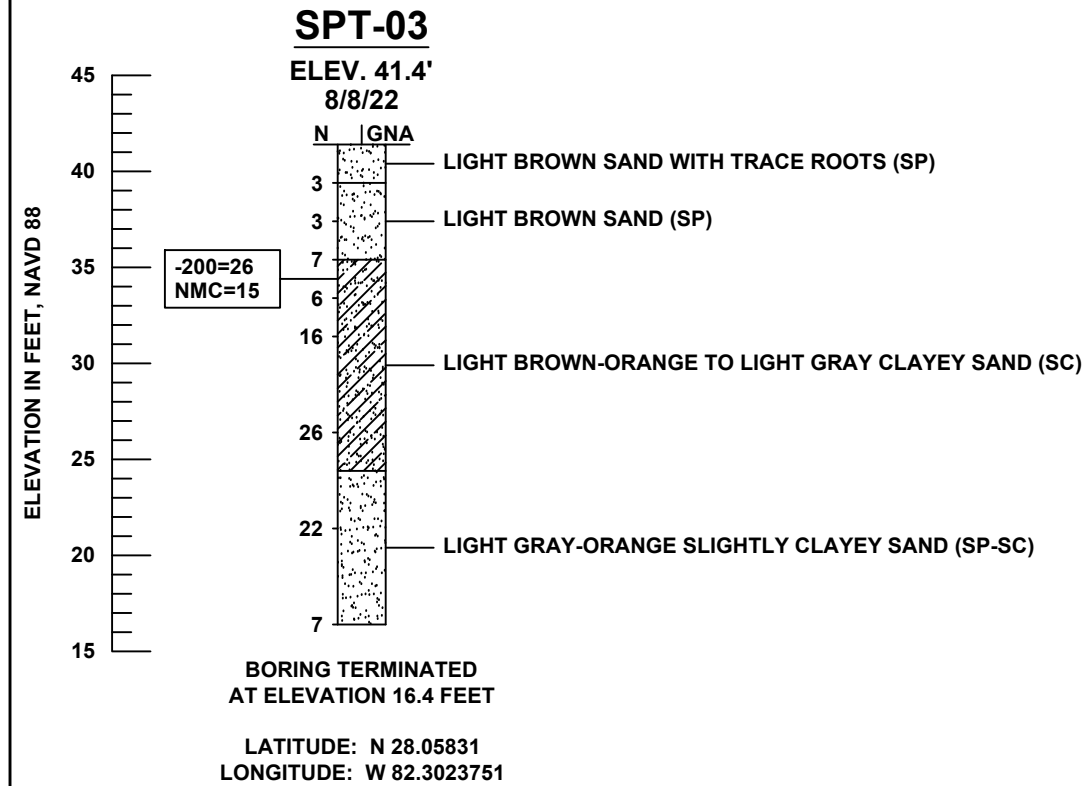
 AREHNA Engineering, Inc.
5012 West Lemon Street, Tampa, FL 33609
Phone 813.944.3464 | Fax 813.944.4959
Certificate of Authorization No. 28410

BORING LOCATION PLAN	

NAME	DATE
DESIGNED BY: GA	8/2022
DRAWN BY: DG	8/2022
CHECKED BY: KH	8/2022
SUPERVISED BY: Kevin M. Hill, P.E.	

PROJECT NAME	PROJECT NO.	SHEET NO.
THONOTOSASSA FIRE STATION 21 THONOTOSASSA, FLORIDA	B-22-116	2

LEGEND



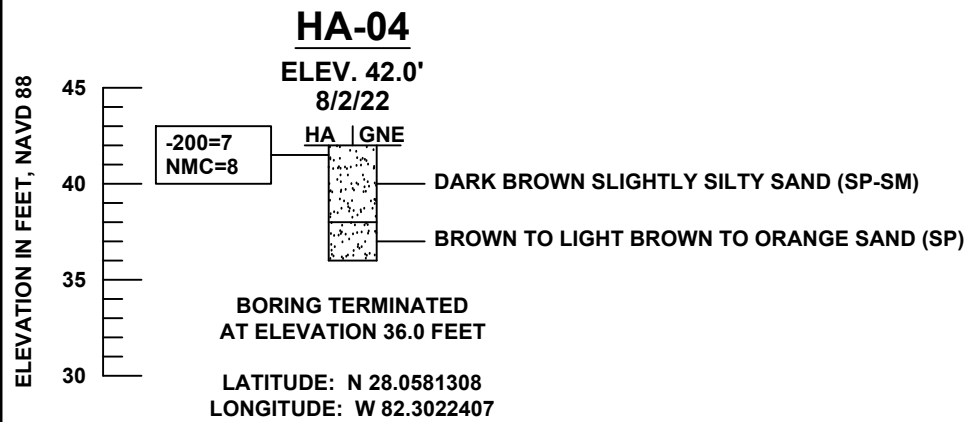
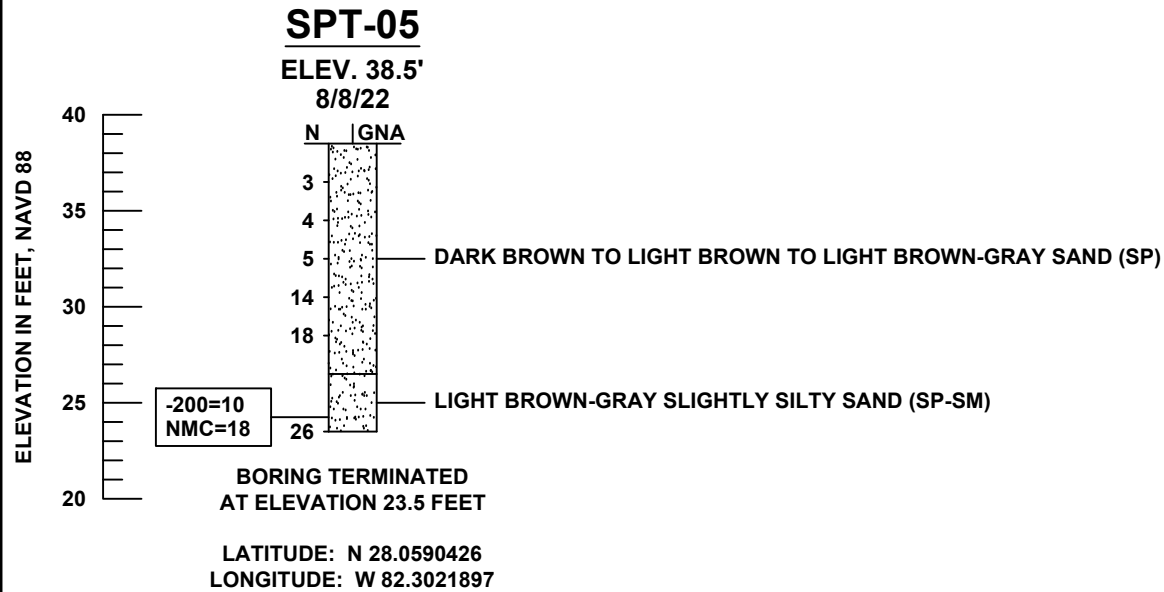
	SAFETY HAMMER	AUTOMATIC HAMMER
GRANULAR MATERIALS- RELATIVE DENSITY	SPT (BLOWS/FT)	SPT (BLOWS/FT)
VERY LOOSE	LESS THAN 4	LESS THAN 3
LOOSE	4 to 10	3 to 8
MEDIUM	10 to 30	8 to 24
DENSE	30 to 50	24 to 40
VERY DENSE	GREATER THAN 50	GREATER THAN 40
SILTS AND CLAYS CONSISTENCY	SPT (BLOWS/FT)	SPT (BLOWS/FT)
VERY SOFT	LESS THAN 2	LESS THAN 1
SOFT	2 to 4	1 to 3
FIRM	4 to 8	3 to 6
STIFF	8 to 15	6 to 12
VERY STIFF	15 to 30	12 to 24
HARD	GREATER THAN 30	GREATER THAN 24

Soil Profile Notes:

1. The profiles depicted are of a generalized nature to highlight the major subsurface stratification features and material characteristics. The soil profiles include soil description, stratifications and penetration resistances. The stratifications shown on the boring profiles represent the conditions only at the actual boring location. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual.
2. The Boring Locations Presented are Approximate and Based on Hand Held GPS with an Accuracy of +/- 10 Feet.
3. SPT borings were performed using a safety hammer.

REVISIONS NO. DATE DESCRIPTIONS APPROVED  AREHNA Engineering, Inc. 5012 West Lemon Street, Tampa, FL 33609 Phone 813.944.3464 Fax 813.944.4959 Certificate of Authorization No. 28419 SOIL BORING PROFILES				NAME DATE DESIGNED BY: GA 8/2022 DRAWN BY: DG 8/2022 CHECKED BY: KH 8/2022 SUPERVISED BY: Kevin M. Hill, P.E.			PROJECT NAME THONOTOSASSA FIRE STATION 21 THONOTOSASSA, FLORIDA		PROJECT NO. B-22-116	SHEET NO. 3B

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LEGEND

FINE SAND (SP/SP-SM/SP-SC)

CLAYEY SAND (SC)

SP UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2488) GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND/OR LABORATORY TESTING

GNA GROUNDWATER TABLE NOT APPARENT

GNE GROUNDWATER TABLE NOT ENCOUNTERED

N SPT N-VALUE IN BLOWS/FOOT FOR 12 INCHES OF PENETRATION

-200 FINES PASSING THE #200 STANDARD SIEVE (%)

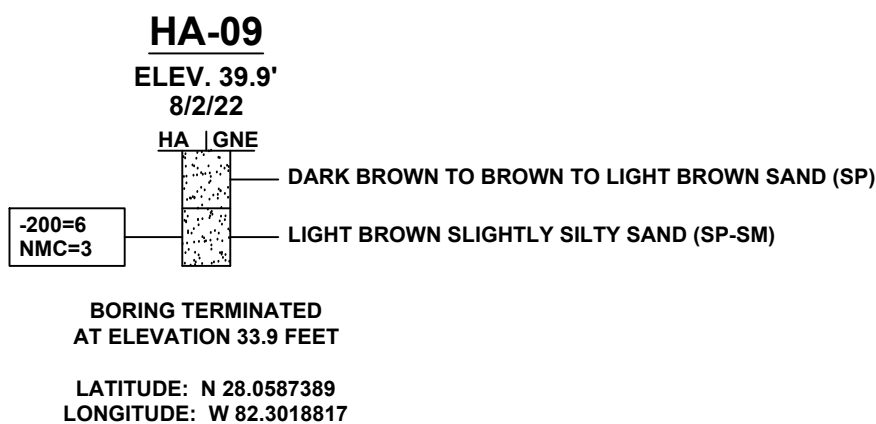
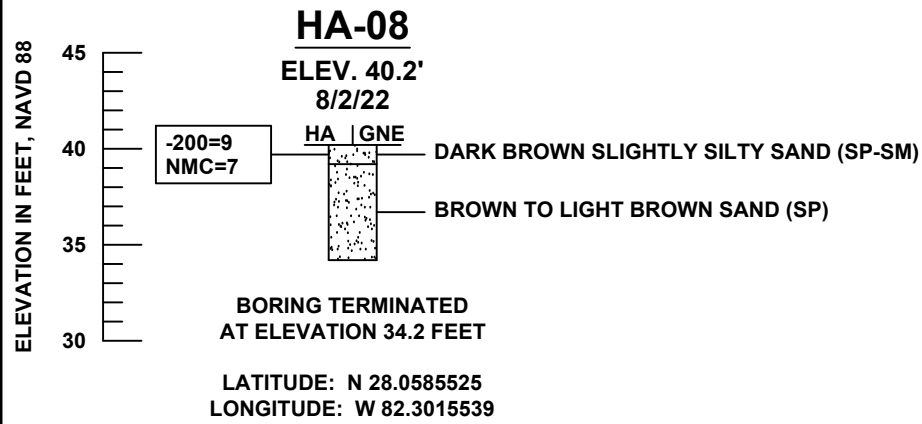
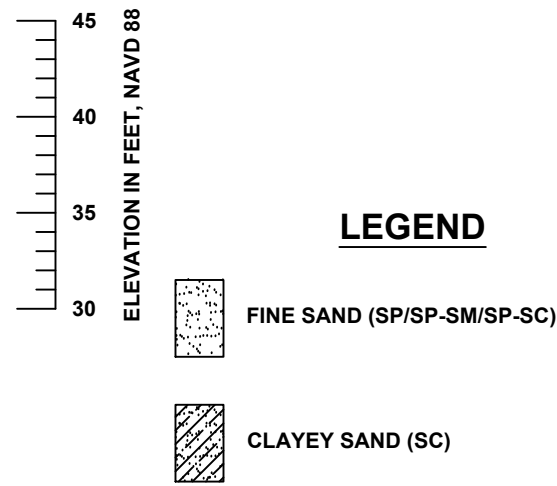
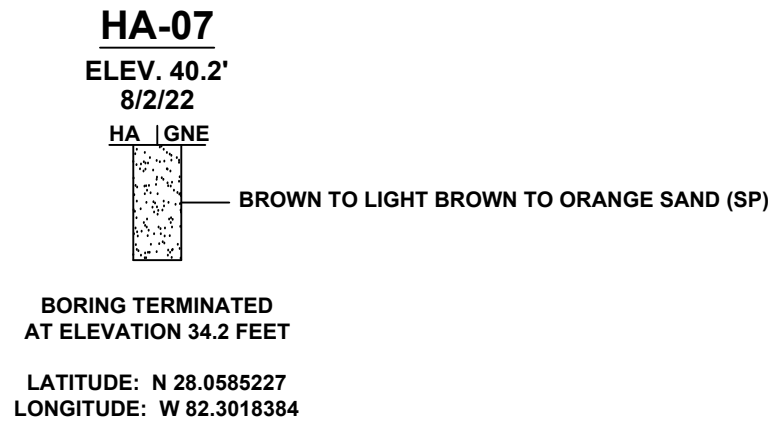
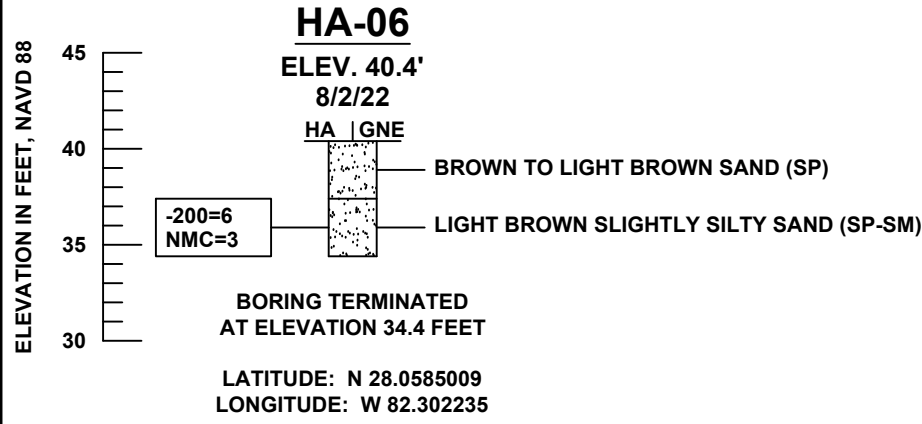
NMC NATURAL MOISTURE CONTENT (%)

	SAFETY HAMMER	AUTOMATIC HAMMER
GRANULAR MATERIALS-RELATIVE DENSITY	SPT (BLOWS/FT)	SPT (BLOWS/FT)
VERY LOOSE	LESS THAN 4	LESS THAN 3
LOOSE	4 to 10	3 to 8
MEDIUM	10 to 30	8 to 24
DENSE	30 to 50	24 to 40
VERY DENSE	GREATER THAN 50	GREATER THAN 40
SILTS AND CLAYS CONSISTENCY	SPT (BLOWS/FT)	SPT (BLOWS/FT)
VERY SOFT	LESS THAN 2	LESS THAN 1
SOFT	2 to 4	1 to 3
FIRM	4 to 8	3 to 6
STIFF	8 to 15	6 to 12
VERY STIFF	15 to 30	12 to 24
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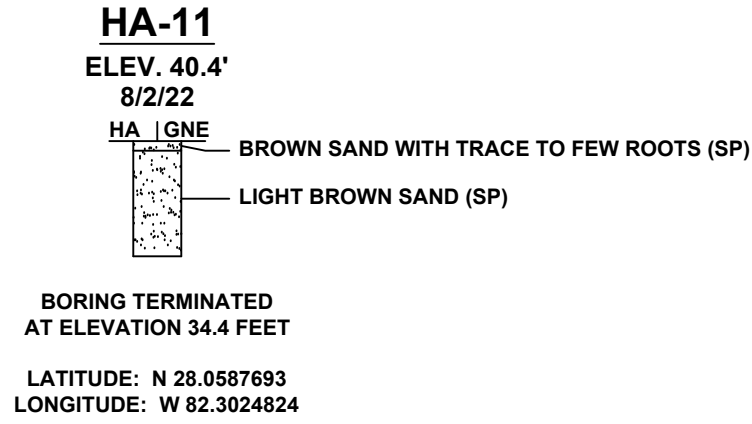
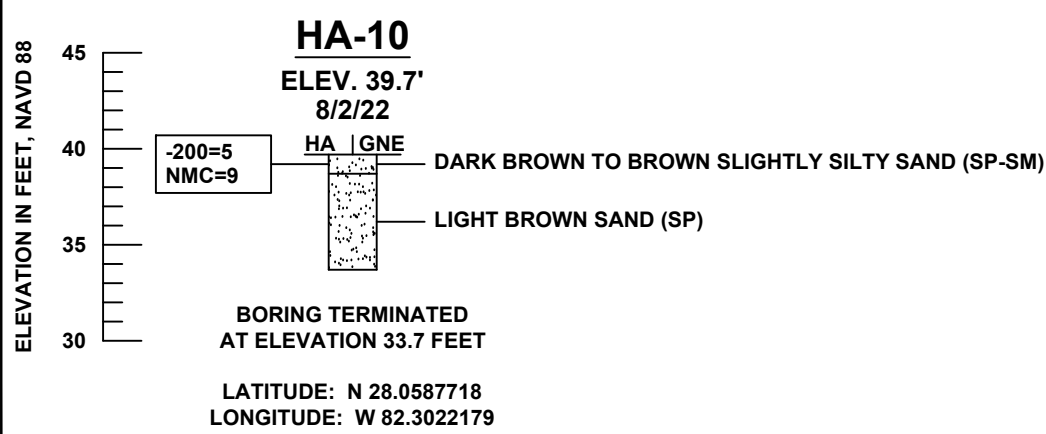
Soil Profile Notes:

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- The Boring Locations Presented are Approximate and Based on Hand Held GPS with an Accuracy of +/- 10 Feet.
- SPT borings were performed using a safety hammer.

REVISIONS			PREPARED BY:	NAME	DATE	PROJECT NAME	PROJECT NO.	SHEET NO.
NO.	DATE	DESCRIPTIONS						
			 AREHNA Engineering, Inc. 5012 West Lemon Street, Tampa, FL 33609 Phone 813.944.3464 Fax 813.944.4959 Certificate of Authorization No. 28410	DESIGNED BY:	GA	8/2022	THONOTOSASSA FIRE STATION 21 THONOTOSASSA, FLORIDA	B-22-116
				DRAWN BY:	DG	8/2022		
				CHECKED BY:	KH	8/2022		
				SUPERVISED BY:	Kevin M. Hill, P.E.			
							3C	



- SP UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2488) GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND/OR LABORATORY TESTING
- GNA GROUNDWATER TABLE NOT APPARENT
- GNE GROUNDWATER TABLE NOT ENCOUNTERED
- N SPT N-VALUE IN BLOWS/FOOT FOR 12 INCHES OF PENETRATION
- 200 FINES PASSING THE #200 STANDARD SIEVE (%)
- NMC NATURAL MOISTURE CONTENT (%)



	SAFETY HAMMER	AUTOMATIC HAMMER
GRANULAR MATERIALS-RELATIVE DENSITY	SPT (BLOWS/FT)	SPT (BLOWS/FT)
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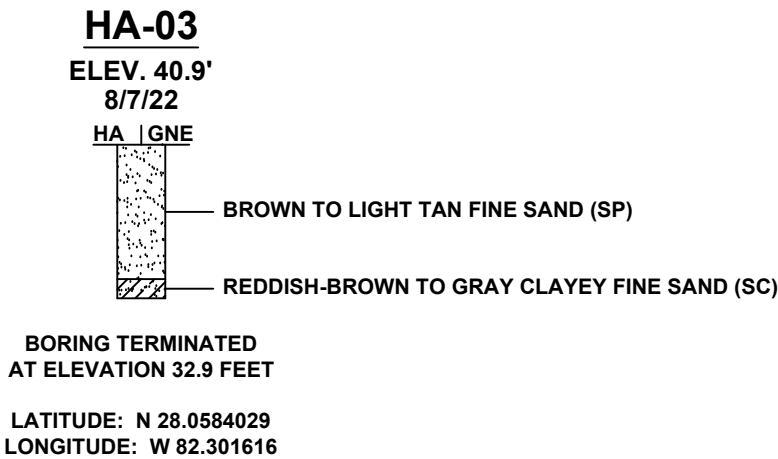
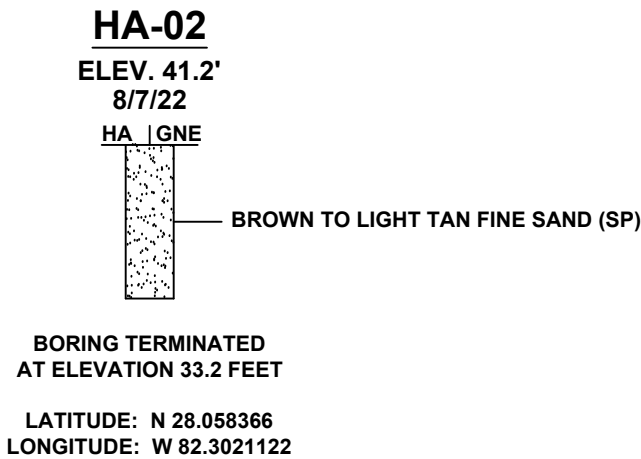
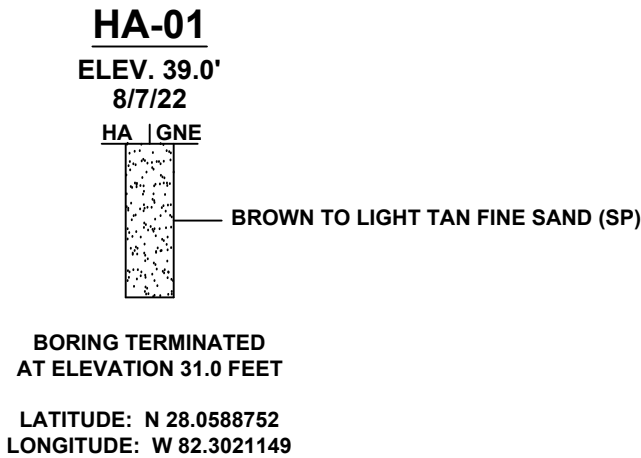
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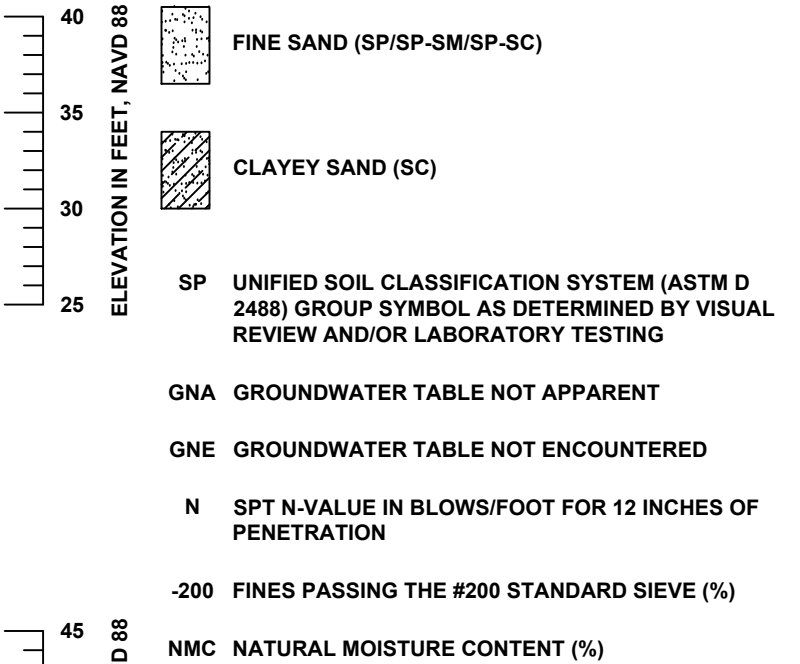
REVISIONS				PREPARED BY:  AREHNA Engineering, Inc. 5012 West Lemon Street, Tampa, FL 33609 Phone 813.944.3464 Fax 813.944.4959 Certificate of Authorization No. 28410	SOIL BORING PROFILES	NAME		DATE	PROJECT NAME	PROJECT NO.	SHEET NO.
NO.	DATE	DESCRIPTIONS	APPROVED			DESIGNED BY:	GA	8/2022			
						DRAWN BY: <th>DG</th> <th>8/2022</th>	DG	8/2022			
						CHECKED BY: <th>KH</th> <th>8/2022</th>	KH	8/2022			
						SUPERVISED BY: <td colspan="2">Kevin M. Hill, P.E.</td>	Kevin M. Hill, P.E.				

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LEGEND



	SAFETY HAMMER	AUTOMATIC HAMMER
GRANULAR MATERIALS-RELATIVE DENSITY	SPT (BLOWS/FT)	SPT (BLOWS/FT)
VERY LOOSE	LESS THAN 4	LESS THAN 3
LOOSE	4 to 10	3 to 8
MEDIUM	10 to 30	8 to 24
DENSE	30 to 50	24 to 40
VERY DENSE	GREATER THAN 50	GREATER THAN 40
SILTS AND CLAYS CONSISTENCY	SPT (BLOWS/FT)	SPT (BLOWS/FT)
VERY SOFT	LESS THAN 2	LESS THAN 1
SOFT	2 to 4	1 to 3
FIRM	4 to 8	3 to 6
STIFF	8 to 15	6 to 12
VERY STIFF	15 to 30	12 to 24
HARD	GREATER THAN 30	GREATER THAN 24

Soil Profile Notes:

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REVISIONS				PREPARED BY:  AREHNA Engineering, Inc. 5012 West Lemon Street, Tampa, FL 33609 Phone 813.944.3464 Fax 813.944.4959 Certificate of Authorization No. 28410	NAME			DATE	PROJECT NAME		PROJECT NO.	SHEET NO.
NO.	DATE	DESCRIPTIONS	APPROVED		DESIGNED BY:	GA	8/2022	THONOTOSASSA FIRE STATION 21 THONOTOSASSA, FLORIDA	B-22-116	3E		
					DRAWN BY:	DG	8/2022					
					CHECKED BY:	KH	8/2022					
					SUPERVISED BY:		Kevin M. Hill, P.E.					
					SOIL BORING PROFILES							

APPENDIX B

Summary of Laboratory Test Results – Table 1
Summary of Double Ring Infiltration Test Results
Field and Laboratory Test Procedures

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS
 THONOTOSASSA FIRE STATION 21
 THONOTOSASSA , FLORIDA
 AREHNA Project No. B-22-116

Boring No.	Sample Depth (feet)	USCS Classification	Sieve Analysis (% Passing)	Natural Moisture Content (%)
			#200	
SPT-01	23.5' - 25.0'	SC	24.5	23.9
SPT-02	18.5' - 20.0'	SC	15.3	20.6
SPT-03	6.0' - 8.0'	SC	25.9	15.2
SPT-04	0.0' - 2.0'	SP-SM	6.6	5.5
SPT-05	13.5' - 15.0'	SP-SM	10.0	18.4
HA-04	0.0' - 1.0'	SP-SM	7.2	7.5
HA-05	1.0' - 3.0'	SP-SM	6.2	4.0
HA-06	3.0' - 6.0'	SP-SM	6.0	3.3
HA-08	0.0' - 1.0'	SP-SM	8.7	6.5
HA-09	3.0' - 6.0'	SP-SM	6.3	3.2
HA-10	0.0' - 1.0'	SP-SM	5.3	8.7

SUMMARY OF DOUBLE RING INFILTRATION TEST RESULTS

HILLSBOROUGH COUNTY: THONOTOSASSA FIRE STATION 21
THONOTOSASSA, FLORIDA

AREHNA Project No.: B-22-116

Test: DRI-02 Date of Test: August 2, 2022
Test Depth: 24 inches below ground surface
Outer Ring Diameter: 24 inches Test Procedure: ASTM D-3385
Inner Ring Diameter: 12 inches
Test Duration: 1.5 hours

Groundwater Level: GNE

Time Increments (minutes)	Inner Ring	
	Reading (mL)	Flow (in ³)
15	7000	427
15	7000	427
15	7000	427
15	7000	427
15	7000	427
15	7000	427

Infiltration Rate:	15.1 in/hr

HILLSBOROUGH COUNTY: THONOTOSASSA FIRE STATION 21
THONOTOSASSA, FLORIDA

Test:	DRI-03
Test Depth:	24 inches below ground surface
Outer Ring Diameter:	24 inches
Inner Ring Diameter:	12 inches
Test Duration:	4 hours

Test Procedure: ASTM D-3385

Time Increments (minutes)	Inner Ring	
	Reading (mL)	Flow (in ³)
15	10000	610
15	10000	610
15	10000	610
15	11000	671
15	11000	671
15	10000	610
15	11000	671
15	10000	610
15	11000	671
15	10000	610
15	11000	671
15	10000	610
15	10000	610
15	10000	610
15	10000	610

Infiltration Rate:	22.3 in/hr

FIELD PROCEDURES

Standard Penetration Test (SPT) Borings

The SPT borings are performed in general accordance with ASTM D-1586, "Penetration Test and Split-Barrel Sampling of Soils." A rotary drilling process is used and bentonite drilling fluid is circulated in the boreholes to stabilize the sides and flush the cuttings. At regular intervals, the drilling tools are removed and soil samples are obtained with a standard 2-feet long, 2-inch diameter split-tube sampler. The sampler is first seated 6 inches and then driven an additional foot with blows of a 140-pound hammer falling under its own weight a distance of 30 inches. The number of hammer blows required to drive the sampler the final foot is designated the "Penetration Resistance." The penetration resistance, when properly interpreted, is an index to the soil strength and density.

Auger Boring

The auger borings are performed in general accordance with ASTM D-1452, "Standard Practice for Soil Investigation and Sampling by Auger Borings". Auger borings are advanced manually using a bucket-type hand auger. The soils encountered are identified, in the field, from cuttings brought to the surface by the augering process. Representative soil samples from the auger borings are placed in glass jars and transported to our laboratory where they are examined by an engineer for classification.

Double Ring Infiltration (DRI) Testing

The DRI tests are performed in general accordance with ASTM D3385 "Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer". The 24-inch diameter outer ring is set on the prepared and roughened surface and is driven into the soil to a depth of 6-inches. Care is taken not to disturb the soil adjacent to ring walls. The ring is then checked visually for levelness. The 12-inch diameter inner ring is then set concentrically within the outer ring and pushed and/or driven into the soil using methods described in the above paragraph to set the inner ring into the soil. The inner ring is then checked visually for level and location within the outer ring. Water is poured into both rings using a splash guard to reduce scouring of the soil surface during the testing. The inner ring and annular space is then simultaneously filled with water to a depth of 12 inches. Water is added during the testing to maintain the 12-inch depth and volume that is added during specific intervals is recorded. This water volume represents the volume infiltrated into the soils, and is converted to an infiltration velocity.

LABORATORY PROCEDURES

Water Content

The water content is the ratio, expressed as a percentage, of the weight of water in a given mass of soil to the weight of the solid particles. This test is conducted in general accordance with AASHTO T-265/ASTM D-2974.

Fines Content

In this test, the sample is dried and then washed over a No. 200 mesh sieve. The percentage of soil by weight passing the sieve is the percentage of fines or portion of the sample in the silt and clay size range. This test is conducted in general accordance with AASHTO T-11/ASTM D-1140.



APPENDIX TWO

Utilities Structure, Inc. – Prestressed Concrete Pole US137T11-8656
(Weatherbug Pole)

Utilities Structures, Inc.

PO Box 9303 Ft Myers, FL 33901
Ph. 1-800-798-7653 Fax. 1-941-332-7132
"Your Prestressed Concrete Pole Producer"

USI37TII-8656

Prestressed Concrete Pole

- Pole Weight = 2,780lb
- Wind speed = 150mph V ult
- Exposure "C"
- Wind Gust = 3 seconds
- Gust Factor = 1.2
- Risk Cat. = II
- 2017 FBC 1620 HVHZ, 1609 & 1806
- ASCE 7-10
- Min. Brk. Strength = 2,400#
- Concrete = 6,500lbs @ 28 days
- Grounding Pigtail #6
- Strand = (4) .500" 270ksi Lo Lax

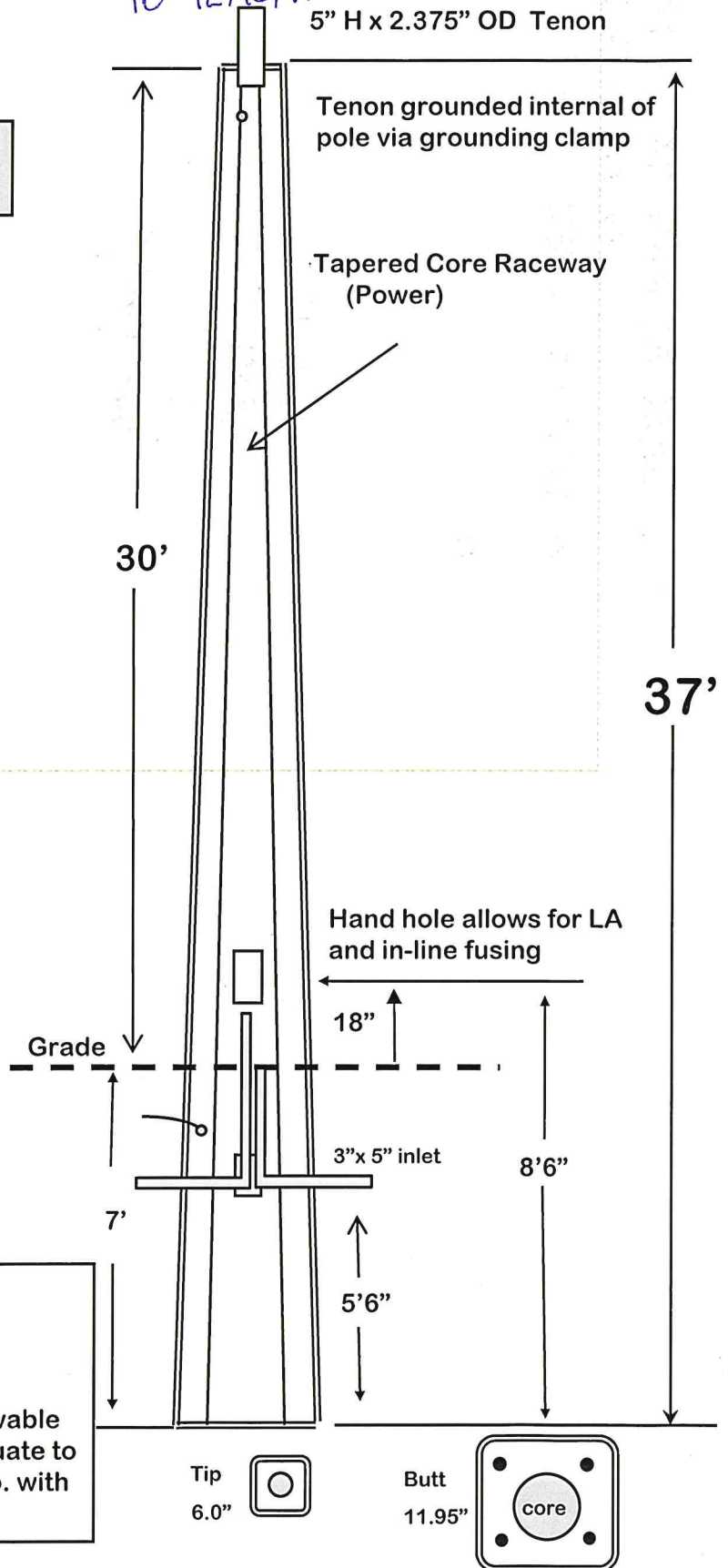
SELECT STRUCTURAL, LLC.

SHAWN R. ANDERSON, P.E., S.E.

PROJECT:

This pole embedded 7' in to soils with an allowable passive pressure of pcf is structurally adequate to resist the local wind speed of Hillsborough Co. with the 1.5sqft epa attached.

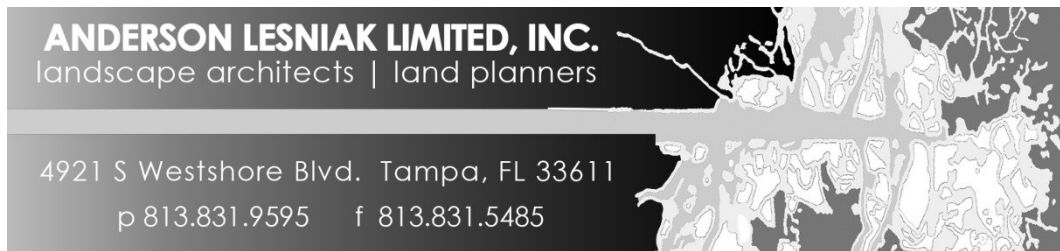
- POLE GROUNDED
- 2" ϕ CONDUIT w/ PULL STRING TERMINATES AT DATA ROOM.
- ADD 3' STICK OUT WITH WEATHERHEADS TO TENON.



Basis OF DESIGN OR EQUAL

APPENDIX THREE

Arborist's Report for Thonotosassa Fire Rescue Station 21- Dated July 23rd 2022
(Anderson Lesniak Limited, Inc.)



Arborist's Report for Thonotosassa Fire Rescue Station 21

Work Requested By: Ms. Lauren Campo, PE – Campo Engineering, Inc.
Scope of Work: Examine existing trees within the limits of work 24" DBH to 33" DBH to determine species type and condition and trees 34" DBH and larger for Grand Tree status and suitability for preservation.

Report: The inspection was conducted on Saturday, July 23rd, 2022, at the parcel located at the northeast corner of Main Street and County Road 579 in Thonotosassa, Hillsborough County, Florida. The tree locations are shown on the survey attached to the end of this report. The trees were examined and their species, DBH size, condition, structure and suitability for preservation were noted. The Condition ratings are explained below. The trees were inspected from the ground for obviously visible defects. No invasive procedures have been used in assessing the trees; thus problems with the trees that are not visually apparent have not been identified and noted. The tree conditions stated are applicable at the time of the inspection.

The Condition ratings for non-grand trees are explained below:

Dead	(require removal)
Poor	(nearly dead, hazardous)
Fair	(declining, diseased, poor structure, potential hazard)
Good	(worthy of preservation but has some minor problems, minor decline, tip die-back)
Outstanding	(healthy tree with very minor problems)
Specimen	(unique in size, age, exceptional quality)

A Grand tree is a tree with a trunk measuring 34" DBH and greater with a condition rating of good or better and with trunk circumference, height and crown measurements totaling a minimum of 175 points in accordance to the Tree Point System Methodology. A tree's condition is determined from the sum of the condition points established from the rating of a tree's roots, trunk, limb/branch structure, twigs and foliage. The condition ratings range from excellent to poor and are determined by a condition point system that weights problems identified on each component of the tree. The condition point system is structured as follows: no apparent problems (4) minor problems (3), major problems (2), and extreme problems (1). The total condition points are as follows: 18-20 Excellent, 15-17 Good, 12-14 Fair and 11 or less Poor.

Tree Number 301 - 36" DBH Live Oak – Quercus Virginiana

North / South Canopy = 47' East / West Canopy = 58' Canopy Height = 61'

$47 + 58$ (canopy spread) = $105 / 2 = 52.5 / 4 = 13$

Tree Point System 36" (DBH) $\times 3.14 = 113 + 13 + 61 = 255$ Points

Roots roots restricted by sidewalk and roadway to south (3)

Trunk co-dominate at 4' height (3)

Limbs canopy leans west, unbalanced (3)

Twigs average shoot vigor (3)

Foliage moderate amount of foliage (3)

Tree Condition Ranking $3 + 3 + 3 + 3 + 3 = 15$ points = Good Condition

GRAND OAK, IN GOOD CONDITION – this tree should be preserved if possible

Tree Number 302 – 32" Live Oak – Quercus Virginiana – Good Condition – well tapered trunk, upright canopy, tree should be preserved if possible

Tree Number 303 - 43" DBH Live Oak – Quercus Virginiana

North / South Canopy = 59' East / West Canopy = 63' Canopy Height = 56'

$59 + 63$ (canopy spread) = $122 / 2 = 61 / 4 = 15.3$

Tree Point System 43" (DBH) $\times 3.14 = 135 + 15 + 56 = 206$ Points

Roots roots restricted by sidewalk and roadway to the south (3)

Trunk co-dominate at 10' HT (3)

Limbs unbalanced canopy leans north (3)

Twigs good shoot vigor (4)

Foliage Average amount of foliage, no disease issues noted (4)

Tree Condition Ranking $3 + 3 + 3 + 4 + 4 = 17$ points = Good Condition

GRAND OAK, IN GOOD CONDITION – this tree should be preserved if possible

Tree Number 304 – 74" Ear Tree – Enterolobium Cyclocarpum – Invasive, not protected, tree should be removed

Tree Number 305 - 54" DBH Camphor Tree – Cinnamomum Camphora – Good Condition, balanced canopy and good overall vigor, tree should be preserved if possible

Tree Number 306 - 56" DBH Live Oak – Quercus Virginiana

North / South Canopy = 69' East / West Canopy = 75' Canopy Height = 63'

$69 + 75$ (canopy spread) = $144 / 2 = 72 / 4 = 18$

Tree Point System 56 (DBH) $\times 3.14 = 176 + 18 + 63 = 257$ Points

Roots no root restrictions (4)

Trunk large lightning wound on trunk (3)

Limbs co-dominate branches (3)

Twigs average vigor (3)

Foliage average amount of foliage (3)

Tree Condition Ranking $4 + 3 + 3 + 3 + 3 = 15$ points = Good Condition

GRAND OAK, IN GOOD CONDITION – this tree should be preserved if possible

Tree Number 307 – 28" Ear Tree – Enterolobium Cyclocarpum – Invasive, not protected, tree should be removed

Tree Number 308 – 30" Laurel Oak – Quercus Laurifolia – Poor Condition – hollows in trunk, dead ends of lateral branches, tree should be removed

Tree Number 309 - 43" DBH Laurel Oak – Quercus Laurifolia

North / South Canopy = 34' East / West Canopy = 28' Canopy Height = 56'

$34 + 28$ (canopy spread) = $62 / 2 = 31 / 4 = 8$

Tree Point System 43 (DBH) $\times 3.14 = 135 + 8 + 56 = 199$ Points

Roots no root restrictions (4)

Trunk hollows in trunk (2)

Limbs dead central leader (1)

Twigs no new growth (1)

Foliage minimal amount of foliage (2)

Tree Condition Ranking $4 + 2 + 1 + 1 + 2 = 10$ points = Poor Condition

NOT A GRAND OAK BECAUSE OF CONDITION – this tree should be removed

Tree Number 311 – 28" Live Oak – Quercus Virginiana – Good Condition – symmetrical canopy, full foliage, some dead ends of upper lateral branches - tree should be preserved if possible

Tree Number 312 – 29" Live Oak – Quercus Virginiana – Good Condition – tapered trunk, symmetrical canopy, tree should be preserved if possible

Tree Number 313 – 26" Laurel Oak – Quercus Laurifolia – Fair Condition – narrow canopy, less than average foliage density

Tree Number 314 – 25” Live Oak – Quercus Virginiana – Good Condition – co-dominate at 12’, narrow canopy, average foliage density

Tree Number 315 - 35” DBH Live Oak – Quercus Virginiana
North / South Canopy = 46’ East / West Canopy = 41’ Canopy Height = 62’
 $46 + 41$ (canopy spread) = $87 / 2 = 43.5 / 4 = 11$
Tree Point System 35 (DBH) x 3.14 = 110 + 11 + 62 = 183 Points
Roots roots restricted on west by roadway (3)
Trunk co-dominate at 8’ (3)
Limbs severe canopy lean to the west (2)
Twigs minimal new growth (2)
Foliage thin foliage density (2)
Tree Condition Ranking 3 + 3 + 2 + 2 + 2 = 12 points = Fair Condition
NOT A GRAND OAK BECAUSE OF CONDITION – this tree should be removed

Tree Number 316 – 30” Laurel Oak – Quercus Laurifolia – Poor Condition – minimal canopy, few lateral branches, minimal foliage - tree should be removed

Tree Number 317 – 29” Live Oak – Quercus Virginiana – Poor Condition – canopy leaning to the west, few lateral branches, minimal foliage - tree should be removed

Tree Number 318 – 21” Live Oak – Quercus Virginiana – Fair Condition – trunk co-dominate at 6’ height, minimal lateral branching - tree should be removed

Tree Number 319 - 37” DBH Laurel Oak – Quercus Laurifolia
North / South Canopy = 42’ East / West Canopy = 67’ Canopy Height = 60’
 $42 + 67$ (canopy spread) = $109 / 2 = 54.5 / 4 = 14$
Tree Point System 37 (DBH) x 3.14 = 116 + 14 + 60 = 190 Points
Roots roots restricted on west side by roadway (3)
Trunk several voids in trunk, co-dominate (2)
Limbs dead ends of laterals (2)
Twigs minimal new growth (2)
Foliage foliage below average density (2)
Tree Condition Ranking 3 + 2 + 2 + 2 + 2 = 11 points = Poor Condition
NOT A GRAND OAK BECAUSE OF CONDITION – this tree should be removed

Tree Number 320 - 57” DBH Live Oak – Quercus Virginiana
North / South Canopy = 91’ East / West Canopy = 83’ Canopy Height = 64’
 $91 + 83$ (canopy spread) = $174 / 2 = 87 / 4 = 22$
Tree Point System 57 (DBH) x 3.14 = 179 + 22 + 64 = 265 Points
Roots no apparent problems (4)
Trunk swollen base, co-dominate @ 5’ (2)
Limbs balanced canopy, some small dead ends of laterals (3)
Twigs good new growth (3)
Foliage average foliage density (3)
Tree Condition Ranking 4 + 2 + 3 + 3 + 3 = 15 points = Good Condition
GRAND OAK, IN GOOD CONDITION – this tree should be preserved if possible

Tree Number 321 – 31” Laurel Oak – Quercus Laurifolia – Poor Condition – dead central leader - tree should be removed

Tree Number 322 – 24” Laurel Oak – Quercus Laurifolia – Fair Condition – many dead laterals branches -tree should be removed

Tree Number 323 – 29” Live Oak – Quercus Virginiana – Poor Condition – trunk leans west, minimal canopy - tree should be removed

Tree Number 324 – 22” Laurel Oak – Quercus Laurifolia – Poor Condition – trunk co-dominate @ 6’, minimal canopy spread, less than average foliage - tree should be removed

Tree Number 325 – 28” Laurel Oak – Quercus Laurifolia – Good Condition – straight trunk, elevated canopy, some small dead branches - tree should be preserved if possible

Tree Number 326 – 26” Live Oak – Quercus Virginiana – Poor Condition – trunk leans to the west, minimal canopy - tree should be removed

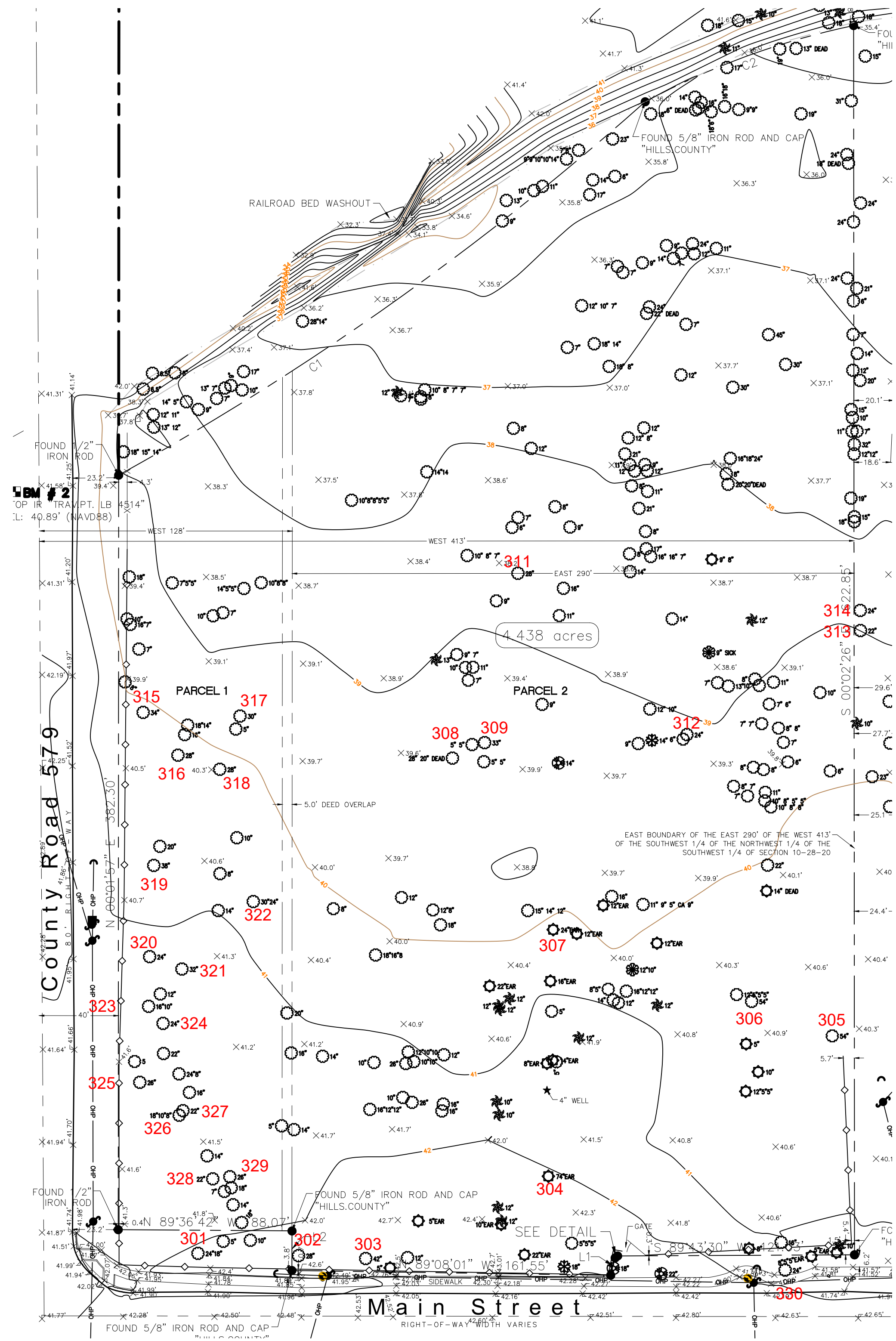
Tree Number 327 – 25” Laurel Oak – Quercus Laurifolia – Good Condition – canopy unbalanced, good foliage density - tree should be preserved if possible

Tree Number 328 – 25” Laurel Oak – Quercus Laurifolia – Good Condition – well tapered trunk, full canopy, good foliage condition - tree should be preserved if possible

Tree Number 329 – 28” Live Oak – Quercus Virginiana – Good Condition – trunk leans east, good canopy structure, average foliage density - tree should be preserved if possible

Tree Number 330 – 25” Live Oak – Quercus Virginiana – Fair Condition – dead wood in trunk, canopy unbalanced to the north - tree should be removed

ARBORIST'S REPORT FOR THONOTOSASSA FIRE RESCUE STATION 21 - PAGE 5



APPENDIX FOUR

Hydraulic Calculations by HydraCALC- Dated 08/29/2024
(Hatcher Engineering, Inc.)



Hydraulic Calculations by HydraCALC

Hatcher Engineering, Inc.
720 Brooker Creek Blvd.
Ste 205
Oldsmar, FL 34677
813-752-6900

Job Name : Fire Station #21, Hillsborough
Drawing : FP1.1
Location : Thonotosassa, FL
Remote Area : 2520-A
Contract : 2022-2520
Data File : 2520-A.WXF
Date/Time : 08/29/2024 - 05:11 PM

HYDRAULIC CALCULATIONS
for

JOB NAME Fire Station #21, Hillsborough
Location Thonotosassa, FL
Drawing # FP1.1
Contract # 2022-2520
Date 8/30/2024

DESIGN

Remote area # 2520-A
Remote area location Apparatus Bay
Occupancy classification Ordinary Hazard (Group 2)
Density 0.20 - Gpm/SqFt
Area of application 1,130 - SqFt
Coverage/sprinkler 130 max - SqFt
Type of sprinkler calculated QR Pendent (k-8.0)
Sprinklers calculated 12
In-rack demand N/A - GPM
Hose streams 0 - GPM
Total water required (including hose streams) 292.6 - GPM @ 54.6 - Psi
Type of system Wet Pipe Sprinkler System (Tree)
Volume of system (dry or pre-action) N/A - Gal

WATER SUPPLY INFORMATION

Test date N/A
Location Fire Pump & water Storage Tank
Source of info

CONTRACTOR INFO

Address
Phone #
Name of designer Richard W. Lyons
Authority having jurisdiction
NOTES:

text1(35) - invisible

Fittings Used Summary

Hatcher Engineering, Inc.
Fire Station #21, Hillsborough

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Date 8/30/2024

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
F	NFPA 13 45' Elbow	1	1	1	1	2	2	3	3	3	4	5	7	9	11	13	17	19	21	24	28
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA

Hatcher Engineering, Inc.
Fire Station #21, Hillsborough

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Date 8/30/2024

SUPPLY ANALYSIS

<i>Node at Source</i>	<i>Static Pressure</i>	<i>Residual Pressure</i>	<i>Flow</i>	<i>Available Pressure</i>	<i>Total Demand</i>	<i>Required Pressure</i>
PUMP	See Information on Pump Curve			86.953	292.64	54.637

NODE ANALYSIS

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>		<i>Notes</i>
101S	16.667	8	7.29	21.6	0.2	108
102S	16.667	8	7.45	21.84	0.2	108
103S	16.667	8	8.05	22.69	0.2	108
104S	16.667	8	7.58	22.03	0.2	40
105S	16.667	8	11.15	26.72	0.2	108
101	17.333		7.85			
102	17.333		8.03			
103	17.333		8.69			
104	17.333		9.45			
105	17.333		12.12			
106S	16.667	8	8.3	23.05	0.2	108
107S	16.667	8	8.49	23.3	0.2	108
108S	16.667	8	9.16	24.21	0.2	108
109S	16.667	8	11.45	27.07	0.2	108
106	17.333		8.97			
107	17.333		9.18			
108	17.333		9.92			
109	17.333		12.45			
110S	16.667	8	10.83	26.32	0.2	108
111S	16.667	8	11.06	26.61	0.2	108
112S	16.667	8	11.56	27.2	0.2	108
110	17.333		11.76			
111	17.333		12.03			
112	17.333		13.26			
1	17.333		12.37			
2	17.333		12.71			
3	17.333		13.52			
4	17.333		13.66			
5	17.333		18.65			
6	10.667		24.66			
7	10.667		32.29			
8	10.667		42.12			
TASR	10.667		45.37			
1AFF	1.0		50.66			
BASE	-3.0		52.84			
UG1	-3.0		56.44			
P1	1.0		54.79			
PUMP	2.0		54.64			

Final Calculations : Hazen-Williams

Hatcher Engineering, Inc.
Fire Station #21, Hillsborough

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Equiv Len	Pipe Ftngs Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
101S to 101	16.667 17.333	8.00	21.60 21.6	1 1.049	T 5.0	0.667 5.000 5.667	120 0.1500	7.290 -0.288 0.850		Vel = 8.02	
101			0.0 21.60					7.852		K Factor = 7.71	
102S to 102	16.667 17.333	8.00	21.84 21.84	1 1.049	T 5.0	0.667 5.000 5.667	120 0.1530	7.453 -0.288 0.867		Vel = 8.11	
102			0.0 21.84					8.032		K Factor = 7.71	
103S to 103	16.667 17.333	8.00	22.69 22.69	1 1.049	T 5.0	0.667 5.000 5.667	120 0.1643	8.047 -0.288 0.931		Vel = 8.42	
103			0.0 22.69					8.690		K Factor = 7.70	
104S to 104	16.667 17.333	8.00	22.03 22.03	1 1.049	E T 2.0 5.0	6.834 7.000 13.834	120 0.1556	7.582 -0.288 2.152		Vel = 8.18	
104			0.0 22.03					9.446		K Factor = 7.17	
105S to 105	16.667 17.333	8.00	26.72 26.72	1 1.049	T 5.0	0.667 5.000 5.667	120 0.2222	11.152 -0.288 1.259		Vel = 9.92	
105			0.0 26.72					12.123		K Factor = 7.67	
101 to 102	17.333 17.333		21.60 21.6	1.5 1.682		12.000 12.000	120 0.0150	7.852 0.0 0.180		Vel = 3.12	
102 to 103	17.333 17.333		21.84 43.44	1.5 1.682		12.000 12.000	120 0.0548	8.032 0.0 0.658		Vel = 6.27	
103 to 104	17.333 17.333		22.69 66.13	1.5 1.682		6.333 6.333	120 0.1194	8.690 0.0 0.756		Vel = 9.55	
104 to 1	17.333 17.333		22.03 88.16	1.5 1.682	T 9.9	4.500 9.900 14.400	120 0.2031	9.446 0.0 2.924		Vel = 12.73	
1			0.0 88.16					12.370		K Factor = 25.07	
105 to 1	17.333 17.333		26.72 26.72	1.5 1.682	T 9.9	1.167 9.900 11.067	120 0.0223	12.123 0.0 0.247		Vel = 3.86	
1			0.0 26.72					12.370		K Factor = 7.60	
106S to 106	16.667 17.333	8.00	23.05 23.05	1 1.049	T 5.0	0.667 5.000 5.667	120 0.1690	8.301 -0.288 0.958		Vel = 8.56	

Final Calculations : Hazen-Williams

Hatcher Engineering, Inc.
Fire Station #21, Hillsborough

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Date 8/30/2024

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Equiv Len	Pipe Ftngs Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
106			0.0 23.05					8.971		K Factor = 7.70	
107S to 107	16.667 17.333	8.00	23.30 23.3	1 1.049	T 5.0	0.667 5.000 5.667	120 0.1726	8.485 -0.288 0.978		Vel = 8.65	
107			0.0 23.30					9.175		K Factor = 7.69	
108S to 108	16.667 17.333	8.00	24.21 24.21	1 1.049	T 5.0	0.667 5.000 5.667	120 0.1851	9.156 -0.288 1.049		Vel = 8.99	
108			0.0 24.21					9.917		K Factor = 7.69	
109S to 109	16.667 17.333	8.00	27.07 27.07	1 1.049	T 5.0	0.667 5.000 5.667	120 0.2276	11.450 -0.288 1.290		Vel = 10.05	
109			0.0 27.07					12.452		K Factor = 7.67	
106 to 107	17.333 17.333		23.05 23.05	1.5 1.682		12.000 12.000	120 0.0170	8.971 0.0 0.204		Vel = 3.33	
107 to 108	17.333 17.333		23.30 46.35	1.5 1.682		12.000 12.000	120 0.0618	9.175 0.0 0.742		Vel = 6.69	
108 to 2	17.333 17.333		24.21 70.56	1.5 1.682	T 9.9	10.833 9.900 20.733	120 0.1345	9.917 0.0 2.788		Vel = 10.19	
2			0.0 70.56					12.705		K Factor = 19.80	
109 to 2	17.333 17.333		27.07 27.07	1.5 1.682	T 9.9	1.167 9.900 11.067	120 0.0229	12.452 0.0 0.253		Vel = 3.91	
2			0.0 27.07					12.705		K Factor = 7.59	
110S to 110	16.667 17.333	8.00	26.32 26.32	1 1.049	T 5.0	0.667 5.000 5.667	120 0.2163	10.827 -0.288 1.226		Vel = 9.77	
110			0.0 26.32					11.765		K Factor = 7.67	
111S to 111	16.667 17.333	8.00	26.61 26.61	1 1.049	T 5.0	0.667 5.000 5.667	120 0.2206	11.063 -0.288 1.250		Vel = 9.88	
111			0.0 26.61					12.025		K Factor = 7.67	
112S to 112	16.667 17.333	8.00	27.20 27.2	1 1.049	E T 5.0	1.667 7.000 8.667	120 0.2297	11.560 -0.288 1.991		Vel = 10.10	
			0.0								

Final Calculations : Hazen-Williams

Hatcher Engineering, Inc.
Fire Station #21, Hillsborough

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqiv	Len	Pipe Ftngs Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
112			27.20						13.263		K Factor = 7.47	
110 to 111	17.333 17.333		26.32	1.5			12.000	120	11.765 0.0			
111 to 4	17.333 17.333		26.32	1.682			12.000	0.0217	0.260		Vel = 3.80	
111 to 4	17.333 17.333		26.61	1.5	T	9.9	10.833 9.900	120	12.025 0.0			
4			52.93	1.682			20.733	0.0791	1.639		Vel = 7.64	
4			0.0 52.93						13.664		K Factor = 14.32	
112 to 3	17.333 17.333		27.20	1.5	T	9.9	1.167 9.900	120	13.263 0.0			
3			27.2	1.682			11.067	0.0230	0.255		Vel = 3.93	
3			0.0 27.20						13.518		K Factor = 7.40	
1 to 2	17.333 17.333		114.88	2.5			9.000	120	12.370 0.0			
2 to 3	17.333 17.333		114.88	2.635			9.000	0.0372	0.335		Vel = 6.76	
2 to 3	17.333 17.333		97.63	2.5			7.000	120	12.705 0.0			
3 to 4	17.333 17.333		212.51	2.635			7.000	0.1161	0.813		Vel = 12.50	
3 to 4	17.333 17.333		27.20	2.5			1.000	120	13.518 0.0			
4 to 5	17.333 17.333		239.71	2.635			1.000	0.1460	0.146		Vel = 14.10	
4 to 5	17.333 17.333		52.93	2.5	E	8.237	15.500 8.237	120	13.664 0.0			
5 to 6	17.333 10.667		292.64	2.635			23.737	0.2100	4.984		Vel = 17.22	
5 to 6	17.333 10.667		0.0	2.5	E	8.237	6.667 8.237	120	18.648 2.887			
6 to 7	10.667 10.667		292.64	2.635			14.904	0.2099	3.129		Vel = 17.22	
6 to 7	10.667 10.667		0.0	2.5	T	16.474	19.833 16.474	120	24.664 0.0			
7 to 8	10.667 10.667		292.64	2.635			36.307	0.2100	7.624		Vel = 17.22	
7 to 8	10.667 10.667		0.0	2.5	T	16.474	30.333 16.474	120	32.288 0.0			
8 to TASR	10.667 10.667		292.64	2.635			46.807	0.2100	9.828		Vel = 17.22	
8 to TASR	10.667 10.667		0.0	2.5	E	8.237	7.250 8.237	120	42.116 0.0			
TASR			292.64	2.635			15.487	0.2100	3.252		Vel = 17.22	
TASR			0.0 292.64						45.368		K Factor = 43.45	
TASR to 1AFF	10.667 1		292.64	4	S B	28.968 15.8	9.667 44.768	120	45.368 4.187			
1AFF to BASE	1 -3		292.64	4.26			54.435	0.0202	1.101		Vel = 6.59	
1AFF to BASE	1 -3		0.0	4	E	14.534	10.000 14.534	140	50.656 1.732			
BASE to UG1	-3 -3		292.64	4.1			24.534	0.0184	0.451		Vel = 7.11	
BASE to UG1	-3 -3		0.0	4	4F	25.491	190.000 25.491	150	52.839 0.0			
UG1			292.64	4.07			215.491	0.0167	3.604		Vel = 7.22	

Final Calculations : Hazen-Williams

Hatcher Engineering, Inc.
Fire Station #21, Hillsborough

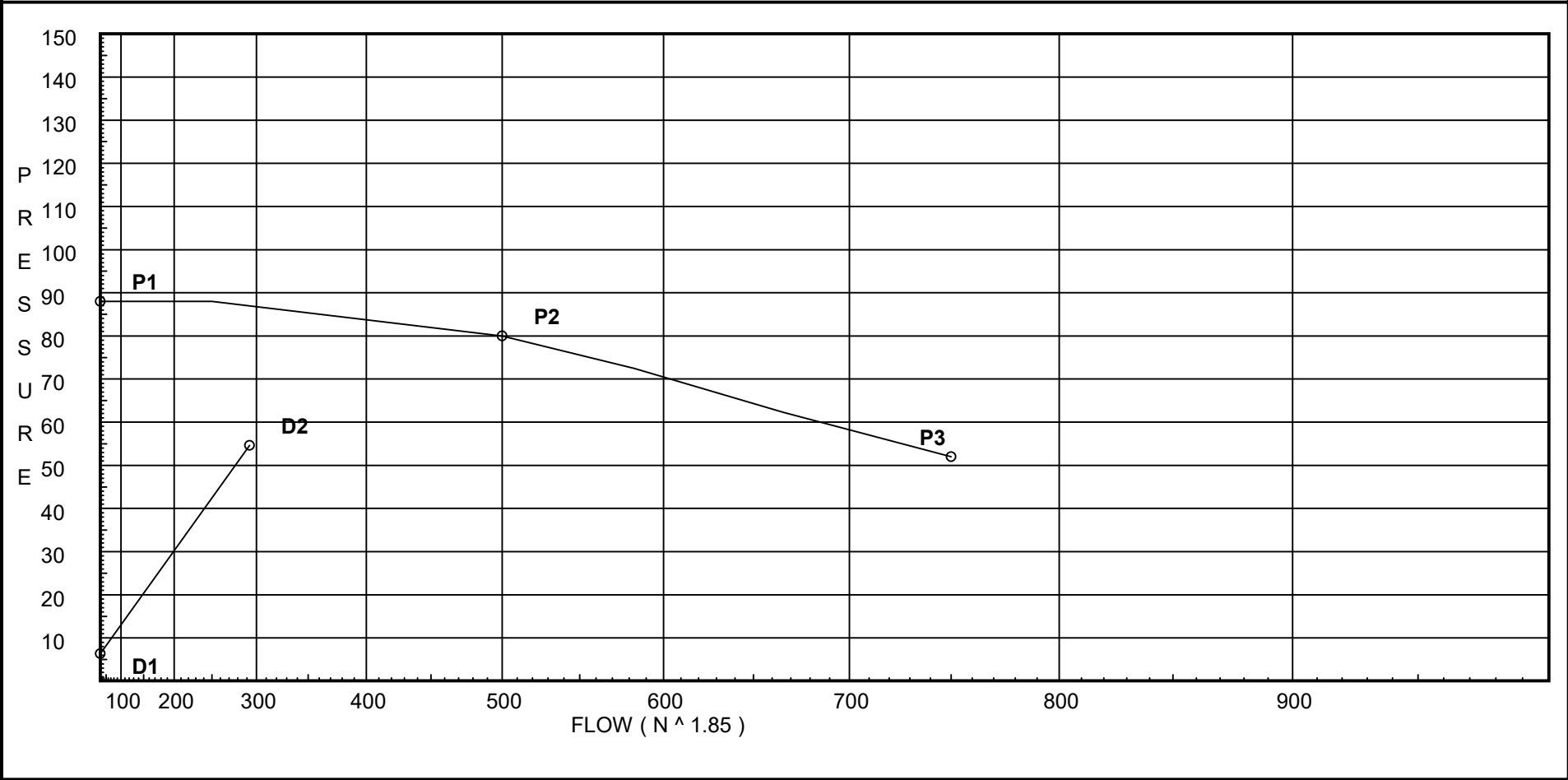
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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Equiv Len	Pipe Ftngs Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
UG1 to P1	-3 1		0.0 292.64	6 6.16	E	20.084 20.084 30.084	140 0.0025	56.443 -1.732 0.075		Vel = 3.15	
P1 to PUMP	1 2		0.0 292.64	6 6.357	T B S	37.72 12.573 40.235	8.000 90.528 98.528	120 -0.433 0.284		Vel = 2.96	
PUMP			0.0 292.64					54.637		K Factor = 39.59	

Water Supply Curve

Hatcher Engineering, Inc.
Fire Station #21, Hillsborough

Pump Data:		Demand:	
P1 - Pump Churn Pressure	: 88	D1 - Elevation	: 6.352
P2 - Pump Rated Pressure	: 80	D2 - System Flow	: 292.639
P2 - Pump Rated Flow	: 500	D2 - System Pressure	: 54.637
P3 - Pump Pressure @ Max Flow	: 52	Hose (Demand)	:
P3 - Pump Max Flow	: 750	D3 - System Demand	: 292.639
		Safety Margin	: 32.316





F1FR80 Series Quick-Response Sprinklers

K-factor 8.0 (115)

Features

- Standard coverage quick-response sprinklers
- Upright and pendent orientations
- Low profile, compact design
- Available in a wide variety of finishes
- Available as Intermediate Level sprinklers

Product Description

Reliable Model F1FR80 series sprinklers are quick-response standard spray automatic fire sprinklers utilizing a sensitive 3mm glass bulb thermal element.

Pendent sprinklers may be installed exposed, or surface mounted using escutcheons such as the Reliable Models B, C, or HB (reference Technical Bulletin 204). When installed recessed, the Model F1FR80 series sprinklers are specifically listed with and may only be installed with listed Reliable recessed escutcheons. Refer to the technical information on the following pages for specific listings for recessed installations and refer to Figure 3 for dimensional information.

When fitted with an approved Reliable water shield, these sprinklers may be considered intermediate sprinklers for use in racks, below grated walkways, and other areas where intermediate level sprinklers are required.

Table A provides a summary of the approvals and availability of specific Model F1FR series sprinkler configurations. Additional technical information for each sprinkler model is provided on the following pages.



Model F1FR80
Upright Sprinkler



Model F1FR80 Pendent Sprinkler

Note: Not all versions of the product are shown.

F1FR80 Series Sprinkler Summary

Table A

Sprinkler Model	K-Factor gpm/psi ^{1/2} (lpm/bar ^{1/2})	Max. Working Pressure psi (bar)	Listings & Approvals	Orientation	Sprinkler Identification Number (SIN)
F1FR80	8.0 (115)	175 (12) 250 (17) (cULus only)	cULus, FM, LPCB, VdS, CE, UKCA	Upright	RA6322
				Pendent	RA6312

Model F1FR80 Upright Sprinkler

SIN RA6322

Technical Specifications

Style: Upright
Threads: 3/4" NPT or ISO 7-R3/4
Nominal K-Factor: 8.0 (115)
Max. Working Pressure:
 175 psi (12 bar)
 250 psi (17 bar) (cULus only)

Material Specifications

Thermal Sensor: 3 mm Glass Bulb
Sprinkler Frame: Brass Alloy
Cap: Bronze Alloy
Sealing Washer: Nickel with PTFE
Load Screw: Copper Alloy
Deflector: Brass Alloy

Sprinkler Finishes

(See Table B)

Sensitivity

Quick response

Temperature Ratings

135°F (57°C)
 155°F (68°C)
 175°F (79°C)
 200°F (93°C)
 286°F (141°C)

Guards & Shields

F-1 Guard (cULus, FM)
 F-2 Guard (FM)
 F-3 Guard with Shield (cULus, FM)
 Factory Installed Shield (cULus, FM)

Sprinkler Wrenches

Model W2
 Model J (with guard installed)

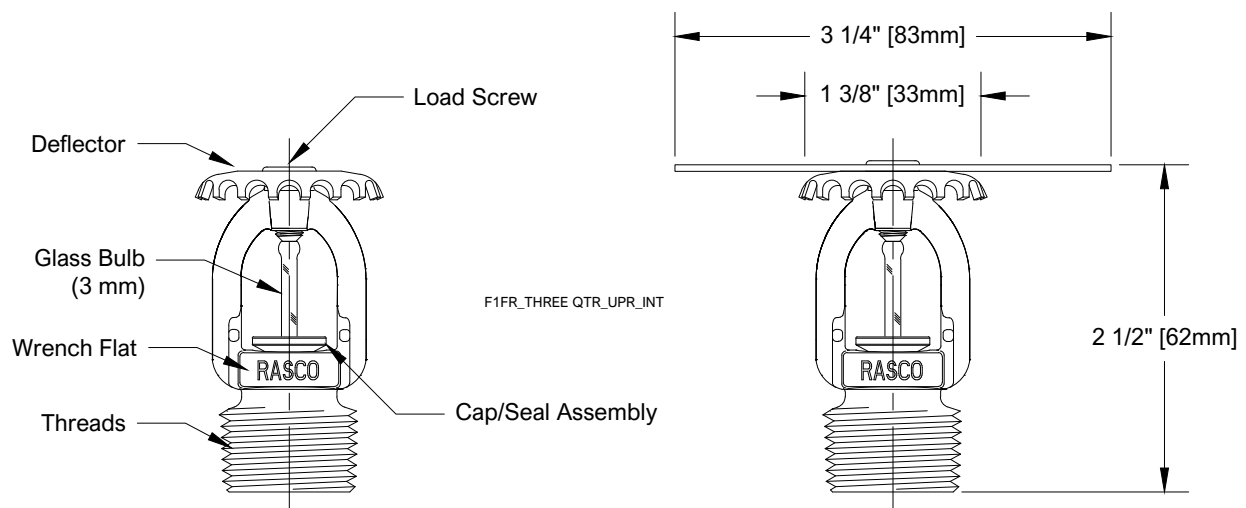
Listings and Approvals

cULus
 FM
 LPCB
 VdS
 CE
 UKCA: 0832-UKCA-CPR-S5078



Model F1FR80 Upright Sprinkler Components and Dimensions

Figure 1



Shown with Optional
 Factory Installed Water Shield
 (Intermediate Upright)

Technical Specifications**Style:**

Pendent
Recessed Pendent

Threads: 3/4" NPT or ISO 7-R3/4**Nominal K-Factor:** 8.0 (115)**Max. Working Pressure:**

175 psi (12 bar)
250 psi (17 bar) (cULus only)

Material Specifications**Thermal Sensor:** 3 mm Glass Bulb**Sprinkler Frame:** Brass Alloy**Cap:** Bronze Alloy**Sealing Washer:** Nickel with PTFE**Load Screw:** Copper Alloy**Deflector:** Brass Alloy**Sprinkler Finishes**

(See Table B)

Sensitivity

Quick response

Temperature Ratings⁽¹⁾

135°F (57°C)
155°F (68°C)
175°F (79°C)
200°F (93°C)
286°F (141°C)

Recessed Escutcheons

Model F1 (cULus)
Model F2 (cULus, FM)
Model FP (cULus)

Guards & Shields⁽²⁾

F-2 Guard (FM)
F-6 Guard/Shield Kit (FM)
F-7 Guard (cULus)
F-8 Guard/Shield Kit (cULus)
S-2 Shield (cULus, FM)

Sprinkler Wrenches

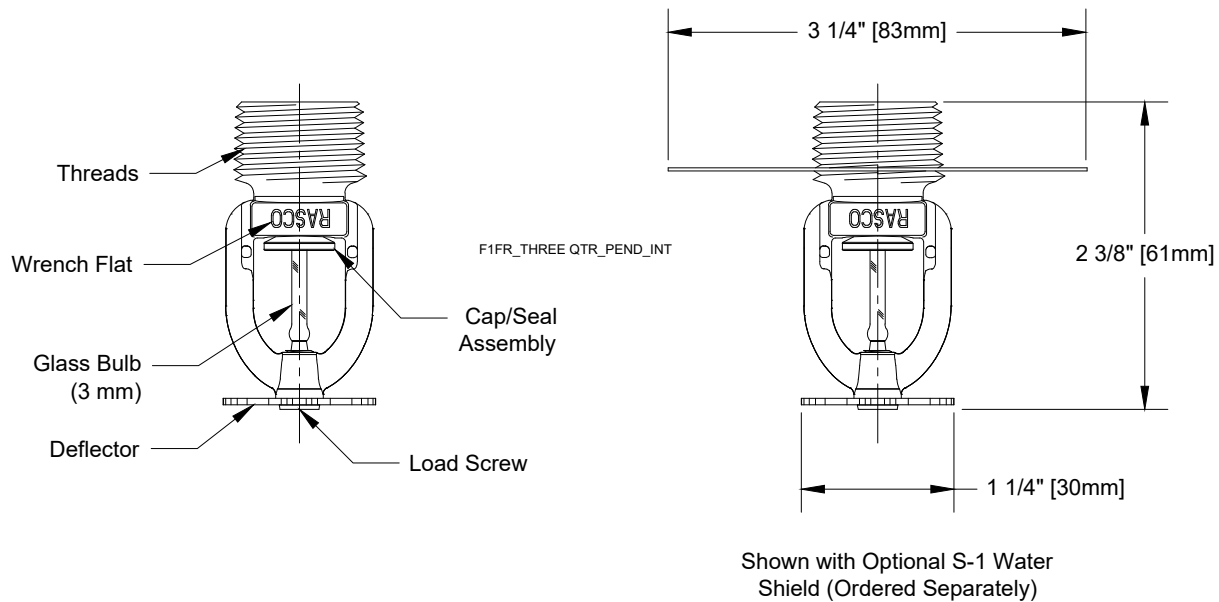
Model W2 (pendent)
Model W4 (recessed)
Model J (with guard installed)

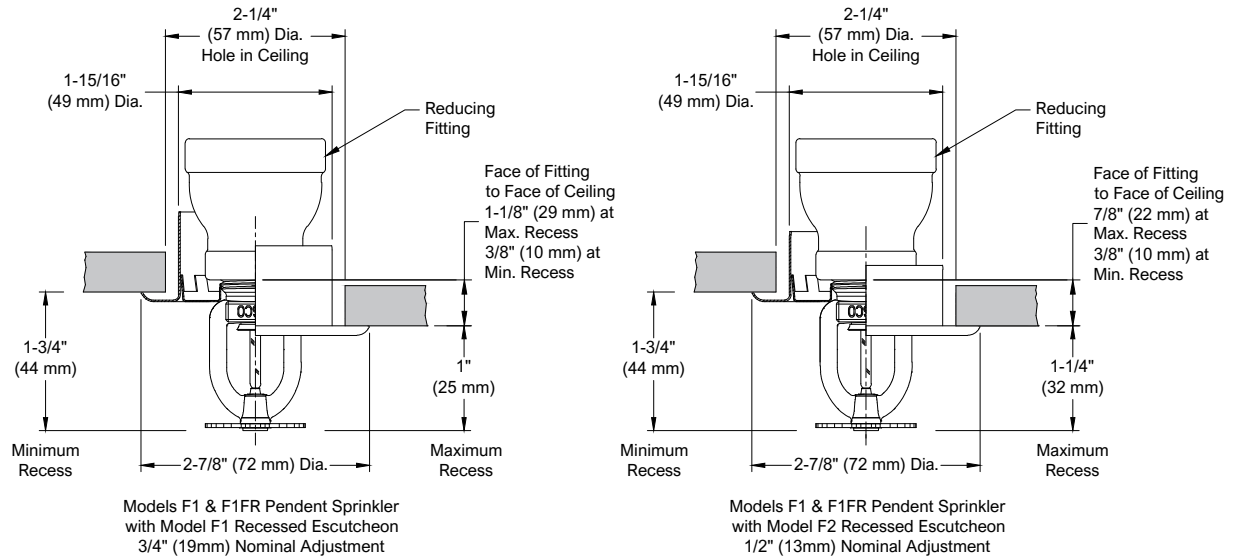
Listings and Approvals⁽³⁾

cULus Listed
FM Approved
LPCB
VdS
CE
UKCA: 0832-UKCA-CPR-S5079

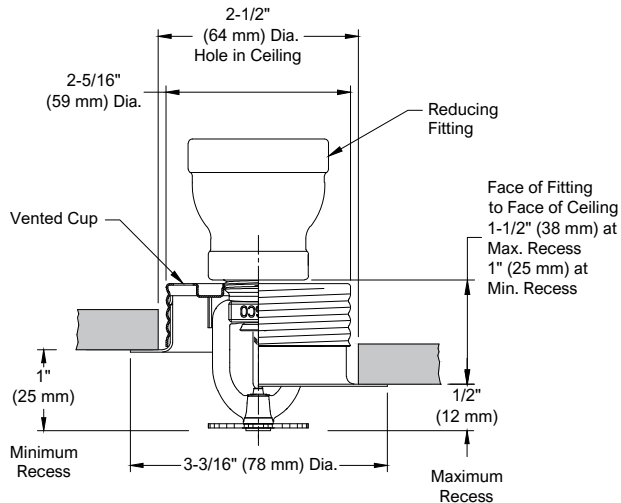
**Notes:**

1. 286°F (141°C) temperature rated sprinkler not listed for recessed use.
2. Not suitable for recessed pendent installations.
3. When used surface mounted or exposed. See Recessed Escutcheon section for specific approvals when installed recessed.

Model F1FR80 Pendent Sprinkler Components and Dimensions**Figure 2****Note:** Please refer to Figure 3 for recessed installation.



F1_REC_PEND



Models F1 & F1FR Pendent Sprinkler with Model FP Recessed Escutcheon 1/2" (13mm) Nominal Adjustment

Note: Model FP recessed assemblies may not be used where the pressure in the space above the ceiling is positive with respect to the protected area. Ensure that the openings in the Model FP cup are unobstructed following installation.



Wrenches



Model W2 (upright, pendent)



Model J (with guard installed)



Model W4
(recessed pendent)

Finishes⁽¹⁾

Table B

Standard Finishes		Special Application Finishes	
Sprinkler	F1, F2 and FP ⁽²⁾ Escutcheons	Sprinkler	F1, F2 and FP ⁽²⁾ Escutcheons
Bronze	Brass	Electroless Nickel PTFE ⁽³⁾⁽⁴⁾	Bright Brass
Chrome Plated	Chrome Plated	Bright Brass ⁽⁵⁾	Satin Chrome
White Polyester ⁽³⁾	White Polyester	Satin Chrome	Custom Color Polyester
		Custom Color Polyester ⁽³⁾⁽⁶⁾	

Notes:

1. Paint or any other coating applied over the factory finish will void all approvals and warranties.
2. Model FP escutcheons utilizes a galvanized steel cup with a finished trim ring.
3. cULus Listed as corrosion resistant.
4. FM Approved as corrosion resistant.
5. For 200°F (93°C) maximum temperature rated sprinklers only.
6. cULus Only.

Installation

Model F1FR Series sprinklers must be installed in accordance with NFPA13 and the requirements of all applicable authorities having jurisdiction. Model F1FR Series sprinklers must be installed with the Reliable sprinkler installation wrench identified in this Bulletin. Any other wrench may damage the sprinkler. The Models W2 and W4 wrenches have two sets of jaws. Use the smallest set of jaws that fit on the wrench flats of the sprinkler. A leak tight sprinkler joint can be obtained with a torque of 8 to 18 lb-ft (11 to 24 N-m). Do not tighten sprinklers over the maximum recommended installation torque. Exceeding the maximum recommended installation torque may cause leakage or impairment of the sprinkler.

Glass bulb sprinklers have orange bulb protectors or protective caps to minimize bulb damage during shipping, handling and installation. Reliable sprinkler installation wrenches are designed to install sprinklers with bulb protectors in place. Remove the bulb protector at the time when the sprinkler system is placed in service for fire protection. Removal of the bulb protector before this time may leave the bulb vulnerable to damage. Remove bulb protectors by undoing the clasp by hand. Do not use tools to remove bulb protectors.

Maintenance

Reliable Model F1FR series sprinklers should be inspected and the sprinkler system maintained in accordance with NFPA 25, as well as the requirements of any Authorities Having Jurisdiction.

Prior to installation, sprinklers should remain in the original cartons and packaging until used. This will minimize the potential for damage to sprinklers that could cause improper operation or non-operation.

Do not clean sprinklers with soap and water, ammonia liquid or any other cleaning fluids. Remove dust by gentle vacuuming without touching the sprinkler.

Replace any sprinkler which has been painted (other than factory applied). A stock of spare sprinklers should be maintained to allow quick replacement of damaged or operated sprinklers. Failure to properly maintain sprinklers may result in inadvertent operation or non-operation during a fire event.

Guarantee

For the guarantee, terms, and conditions, visit www.reliablesprinkler.com.

Ordering Information

Specify the following when ordering:

Model

- F1FR80

Deflector/Orientation

- Upright
- Upright Intermediate
- Pendent

Temperature Rating

- See sprinkler technical specifications

Sprinkler Finish

- See Table B

Recessed Escutcheon

- F1
- F2
- FP

Escutcheon Finish

- See Table B

Sprinkler Wrench

- Model W2 (upright and pendent)
- Model W4 (recessed)
- Model J (with guard installed)

NFPA 1142 - FIRE WATER SUPPLY CALCULATION

PROJECT: **FIRE STATION 21**
HILLSBOROUGH COUNTY, FLORIDA

The calculation below for total stored water required for this project/structure is based on the calculation provided in NFPA 1142 (2017 Edition) as allowed by the Florida Fire Prevention Code for Rural Fire Water supplies.

$$WS_{\min} = \frac{VS_{\text{tot}}}{OHC} (CC) \quad \text{Structures Without Exposures}$$

$$WS_{\min} = \frac{VS_{\text{tot}}}{OHC} (CC) \times 1.5 \quad \text{Structures With Exposures}$$

Note: Shaded cells are for user input.

Est. Volume of Structure (VS,tot) =	138,460	cu.ft.	(total volume)
Occupancy Factor, (OHC) =	7.00		(fire station)
Construction Classification (CCC) =	1.50		(Type VB)
Exposure Factor Applied =	1.00		1.0 (No Exposures), 1.5 (Exposures)

Minimum Water Supply (WS,min) = **29,670** gallons

Min. Tank Fill Rate (8 Hour Fill Time)= 62 gpm

Notes Concerning Calculation:

1. Construction Classification Factors are based on NFPA 1142 definitions.
2. Occpancy Factors are based on the Occupancy Classification Factors in NFPA 1142.
3. The water delivery rate available at the Incident shall be per NFPA 1142, Table 4.6.1
 - < 2,500 gallons = 250 gpm delivery rate
 - 2,500-9,999 gallons = 500 gpm delivery rate
 - 10,000-19,999 gallons = 750 gpm delivery rate
 - 20,000 gallons or greater = 1,000 gpm delivery rate

APPENDIX FIVE

Southland Concrete Creations – Concrete Finishing Suggestions
& GC Notes for Grade 3 Grinds



PO Box 290 – Terra Ceia, FL 34250
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www.southlandcreations.com



**Concrete Finishing
Suggestions
And
GC Notes
For
Grade 3 Grinds**

1- 3500psi minimum Blended aggregate size is recommended. High range water reducer helps to keep aggregate close to surface.

2- Fly ash or slag should be kept under 20% if possible. Straight cement is best

3- No Air Entrainment if possible. No calcium chloride

4- Fiber– Only residential type such as Propex Fibermesh 150 (Stealth)

5- Aggregate should be kept close to the surface of the concrete in a consistent concentration.

a. Do not use vibratory screeds such as Vibra Strike as this will embed the aggregate further in the concrete and they tend to leave “tracks” at the ends of the screed where the aggregate is vibrated more. Laser screed with minimal vibration is acceptable.

b. Extreme care must be taken to not walk on the concrete too early or with heeled boots that will embed the aggregate and leave tracks. This is also true of kneeboards that can leave trails by lowering the aggregate. Once we grind the floors to expose the aggregate these issues will become apparent.

c. Troweling should not be done too early or the aggregate can be displaced too far below the surface. Place and finish the concrete so that the sand and cement consolidates well around the rock. Do not “burn” the slab. Only trowel it to a smooth flat surface.



Footprints from troweling too early



Mark from screed board

6- Flatness- The concrete needs to be flat such as FF-50. It is most important that small humps in the range of 0" to 36" apart are flattened because these will be more visible to the eye once the floor is reflecting light. It is also important to keep hand trowel areas matching the flatness of the machine troweled areas such as against walls or edges. Care can be taken around pipes, drains and existing walls where hand troweling may be required.

7- Curing- Water cure by blanket or spray is acceptable. A light coat of dissipating curing compound can be used. Do not apply it heavy since this will "gum up" our diamonds.

A FINAL NOTE- We understand that it is impossible to get a "perfect" slab but by following some of these suggestions we can get much closer to meeting the owners expectations which is everyone's main goal.



Two mixes in the same floor separated by a cold joint will be noticeable on a finished polished floor.



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Contactor Notes

Pre-pour conference- This meeting or conference call is crucial to the success of the project. Adhering to the finishing suggestions will make a substantial difference in the quality of the finish polished concrete floor.

Slab Protection- Construction practices

The floor should be protected from the following:

- **Floor protection-** Use breathable floor protection. (Note- Concrete that cures differently will generally have a different color that can be unsightly. (Ex. A sheet of plywood left on the floor can leave a 4 x 8 pattern in the floor.)
 - A builders board protection card board can be used if the building is dried in and the slab is substantially cured. NOTE: If the slab is not cured the tape used on the seams can block moisture and cause a shadowing effect in the concrete. Ram Board makes a tape similar to medical gauze that is breathable however it is not a strong tape. Please consult with us before selecting your protection if we are not providing it for you.
- **Contaminates-** The following can cause adverse conditions with your concrete.
 - Tape stuck to floor, Glue, Solvents, Pine-Sol, Varnish, Non Breathing Plastics, Visqueen, Liquid Nail, Silicone, Plastics, Plumbers Glue, Foam Insulation, Bond Release Agents, Flux, Oils, Grease, Muriatic Acid, and other chemicals. Do NOT use silicone sprays to "Hold" the lines
 - For burnished concrete or grade 1 polished concrete the following can cause issues:
 - Nails, Paint, Markers (framers often write dimensions of doorways in marker on the slab. Ask them to make that note on the wood framing the doorway), Grease Sticks, Spray Paints, Crayons, Red and yellow chalk.
- **Lifts and Job Boxes-** Be sure to check lifts tires for nails and screws, diaper all equipment from oil and grease drips. Use non marking tires or tire covers on lifts.
- **Trades-** Other potential issues: Pipe cutting, Plumbers glue, Cutting rebar, Dropping large objects and masonry block.

Spills, stains, items stored on the floor

- It is important that wood, sheet goods, insulation boards, plywood, press board, drywall, sections of framing and the like not lay on the slab for extended periods of time. This can alter the moisture content in the slab which leaves a pattern in the finished floor while the concrete cures. Cardboard could be placed between the slab and the stacked material to help minimize unwanted transfers but it is no guarantee.
- Food, Beverages, Oil, Glass, Metal, Paint, Caulk, and Primers may leave stains.

After Polish Protection

- DO NOT TAPE TO THE FLOOR. The tape alters the natural curing process and transfers chemicals to and from the slab causing a change in color that cannot be removed.
- Depending on how close the polishing work is completed to the end of construction a protective covering should be applied to the floors. This covering should offer some breathability.
- If lifts are to be used non-marking tire **covers** are required.
- Use walk-off mats at the doorways

**SPECIFICATIONS
FOR
CONCRETE FINISHING TRENCH POUR BACKS**

1. The intent of this spec is to have the concrete color and finish for the trench pour backs to match the existing concrete as close as possible.
2. MIX DESIGN- The mix design of the concrete should be designed to match the color of the existing concrete as close as possible. A regular rock mix can be used so that the rock can be placed well below the surface. 5000 to 6000 psi mix should be used so that the concrete cures out quicker and can be polished sooner
3. PLACEMENT- Concrete must be screeded and finished flush with the surface of the existing concrete. This is critical for the polished floor process. Do not have the trench concrete lower than the existing concrete.
4. FINISHING-
 - A. The finish on the new concrete will need to closely match the finish of the existing concrete. Example: If the existing finish is a “hard trowel, slick finish” the trench should be done the same.
 - B. Make sure the aggregate is placed well below the surface of the concrete so that the grinding process does not expose the aggregate. A jitterbug will assist with this.
 - C. The use of a “mag trowel” will pull cream to the surface so that a steel trowel can be used for the final finish.