APPENDIX DOCUMENT

October 2014

UDOT :: HOOPER MAINTENANCE STATION

Volume 2 of 2

TOC | TABLE OF CONTENTS - APPENDIX

06 PROJECT SPECIFICATIONS
- 6.1 Project Specifications

07 SITE TECHNICAL INFORMATION
- 7.1 Geotechnical Investigation Report
- 7.2 Alta Survey

6.1 Project Specifications

Technical Specifications are hereto incorporated.

UTAH DEPARTMENT OF TRANSPORTATION
MAINTENANCE STATION #1421

HOOPER, UTAH

PROJECT MANUAL

DATE

Prepared By

ARCHITECTURAL FIRM

CONSTRUCTION DOCUMENTS

DFCM Project No. 14249900

Architect

Architect Name
Address
Phone Number
Fax Number

Structural Engineer

Structural Engineer
Address
Phone Number
Fax Number

Civil Engineer

Civil Engineer
Address
Phone Number
Fax Number

Mechanical Engineer

Mechanical Engineer
Address
Phone Number
Fax Number

Electrical Engineer

Electrical Engineer
Address
Phone Number
Fax Number

Professional Stamps

LIST OF WARRANTIES

NOTE: The following is a listing and brief description of warranties and certifications required by the specification sections. It does not supersede the requirements of the sections nor is it necessarily complete. All sections listed below may not pertain to this Project. Refer to each section for actual requirements. Warranties are to be completed in behalf of the End User and submitted to the Project Manager / General Contractor as part of Project Close-out.

Section Title	Section – Article	Description
Vertical LIft Gates	02831 -	5-year limited warranty
Concrete Waterproofing Admixture	03053 – 4.1	5-year manufacturer warranty
Oliophobic Sealer	03054 – 4.1	Manufacturer warranty
Cast In place Concrete	03300 – 1.5	Two-Year defective concrete guarantee.
Cold-formed Metal Framing	05400 – 1.5	Use qualified welders and comply with American Welding Society (AWS) D1.3.
Metal - Fabrications	05500 – 1.3	Welder certificates signed by Contractor.
	05500 – 1.4	Certify that each welder has satisfactorily passed AWS qualifications.
Metal Stairs	05510 – 1.4	Welder certificates signed by Contractor.
	05510 – 1.5	Certify that each welder has satisfactorily passed AWS qualifications.
Miscellaneous Carpentry	06105 – 1.3	Preservative Treatment certification for wood. Waterborne Preservative Treatment certification for wood. Warranty from manufacturer of each treatment.
Interior Architectural Woodwork	06402 – 1.3	Product certificates signed by woodwork manufacturer.
Solid Surface Fabrications	06650 – 1.4 06651 – 1.7 B	Product certificates signed by manufacturer. Windowsills - Ten years from date of substantial completion.
Roofing	07410 – 1.7	Manufacturer's standard warranty covering failure of the material
Snow Guards	07729 – 1.5.A	Two year manufacturers warranty
Joint Sealants	07901 – 1.4	Certificate attesting compliance with specification requirements and suitable for the use indicated.
Insulated Fiberglass Windows	08574 – 1.6	a. Window and Non-Glass components: 10 years from substantial completion b. Glazing Units: 20 years from substantial completion.
Gypsum Board Assemblies	09255 – 1.4	Certificate of compliance signed by manufacturer

Visual Display Boards	10100 – 1.3	Certification that tackboard materials comply with requirements specified for flame spread ratings.
Toilet and Bath Accessories	10800 – 1.6	15-year warranty for silver spoilage of mirrors. 1-year mechanical parts and accessories.
Ceiling Fans	11999 – 2.2.M	Airfoils & Hub – Lifetime Motor, Gearbox & Controller – 10 years (parts) Labor – 1 year
Basic Materials and Methods	15050 – 1.20	1-year warranty for equipment
Pipe and Pipe Fittings	15060 – 3.28	Welders' certification.
Air System Testing & Balancing	15191-13B	Agency Qualifications
Insulation	15250 – 1.3	Installed by License Insulation Contractor
Air-cooled Condensing Unit	15670 – 1.4	Five-year warranty on compressors.
Power Ventilators	15838 – 1.4A	Certified fan performance curve and certified fan power sound ratings.
Electrical General Provisions	16001 – 1.9	Certificate of approval from inspection authority at completion of the work.

TABLE OF CONTENTS

DOCUMENTS
COVER SHEET
PROFESSIONAL STAMPS
LIST OF WARRANTIES
TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

01010 SUMMARY OF WORK
01027 APPLICATIONS FOR PAYMENT
01035 MODIFICATION PROCEDURES
01040 PROJECT COORDINATION
01050 FIELD ENGINEERING
01095 REFERENCE STANDARDS AND DEFINITIONS
01096 MATERIAL KEYNOTE LEGEND
01200 PROJECT MEETINGS
01300 SUBMITTALS
01400 QUALITY CONTROL SERVICES
01500 TEMPORARY FACILITIES
01600 MATERIALS AND EQUIPMENT
01631 PRODUCT SUBSTITUTIONS
01700 PROJECT CLOSEOUT
01740 WARRANTIES AND BONDS

DIVISION 2 - SITEWORK

02051 GENERAL SITE CONSTRUCTION REQUIREMENTS
02076 IMPERMEABLE MEMBRANES
02110 SITE CLEARING
02200 EARTHWORK
02470 GROUND ANCHORS
02513 ASPHALT CONCRETE PAVING
02514 PORTLAND CEMENT CONCRETE PAVING
02530 SANITARY SEWERAGE
02666 POTABLE WATER SYSTEMS
02720 STORM SEWERAGE SYSTEMS
02765 PAVEMENT MARKINGS
02822 CHAIN LINK FENCES
02831 VERTICAL LIFT GATES

DIVISION 3 - CONCRETE

03052 CONCRETE WATERPROOFING SYSTEM
03053 CONCRETE WATERPROOFING ADMIXTURE
03054 OLIOPHOBIC SEALER
03055 SALT AND WATER BARRIER FOR EXTERIOR CONCRETE
03300 CAST-IN-PLACE CONCRETE
03450 ARCHITECTURAL PRECAST CONCRETE

DIVISION 4 – MASONRY

SECTION NOT INCLUDED

DIVISION 5 - METALS

05400 COLD-FORMED METAL FRAMING
05500 METAL FABRICATIONS
05510 METAL STAIRS
05521 PIPE AND TUBE RAILINGS
05530 GRATINGS

DIVISION 6 - WOOD AND PLASTICS

06105 MISCELLANEOUS CARPENTRY
06173 PLATE CONNECTED WOOD TRUSSES
06402 INTERIOR ARCHITECTURAL WOODWORK
06651 SOLID SURFACE FABRICATIONS

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

07190 WATER REPELLENTS
07210 BUILDING INSULATION
07410 MANUFACTURED ROOF & WALL PANELS, GUTTERS & FLASHING
07729 ROOF SNOW GUARDS
07841 FIRE STOPPING
07842 FIRE RESISTIVE JOINT SYSTEMS
07901 JOINT SEALANTS

DIVISION 8 - DOORS AND WINDOWS

08111 STANDARD STEEL DOORS AND FRAMES
08331 OVERHEAD COILING FIRE DOORS
08360 SECTIONAL OVERHEAD DOORS
08574 FIBERGLASS WINDOWS
08710 DOOR HARDWARE

DIVISION 9 - FINISHES

09255 GYPSUM BOARD ASSEMBLIES
09300 TILE
09511 ACOUSITCAL PANEL CEILINGS
09660 RESILIENT TILE FLOORING
09678 RESILIENT WALL BASE AND ACCESSORIES
09900 PAINTING

DIVISION 10 - SPECIALTIES

10100 VISUAL DISPLAY BOARDS
10155 TOILET COMPARTMENTS
10425 SIGNS
10500 METAL LOCKERS AND STORAGE CABINETS
10522 FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES
10800 TOILET AND BATH ACCESSORIES

DIVISION 11 - EQUIPMENT

11999 CIRCULATION FANS

DIVISION 12 - FURNISHINGS

12511 HORIZONTAL LOUVER BLINDS

DIVISION 13 – SPECIAL CONSTRUCTION

SECTION NOT INCLUDED

DIVISION 14 - CONVEYING SYSTEMS

14620 TROLLEY HOISTS

DIVISION 15 - MECHANICAL

15000 GENERAL MECHANICAL
15050 BASIC MATERIALS & METHODS
15074 VIBRATION & SEISMIC CONTROLS FOR HVAC
15175 MECHANICAL IDENTIFICATION
15180 HVAC & PLUMBING INSULATION
15140 DOMESTIC WATER PIPING
15145 DOMESTIC WATER PIPING SPECIALTIES
15150 SANITARY WASTE AND VENT PIPING
15155 SANITARY WASTE PIPING SPECIALTIES
15195 FACILITY NATURAL-GAS PIPING
15410 PLUMBING FIXTURES
15412 EMERGENCY PLUMBING FIXTURES
15452 DRINKING WATER COOLING SYSTEM
15460 NATURAL GAS FIRED STORAGE-TYPE WATER HEATERS
15530 FURNACES
15542 GAS-FIRED RADIANT HEATERS
15576 FLUES
15671 CONDENSING UNITS
15815 METAL DUCTS
15820 DUCT ACCESSORIES
15838 EXHAUST FANS
15855 DIFFUSERS, REGISTERS, AND GRILLES
15887 LOUVERS
15950 TESTING, ADJUSTING AND BALANCING

15970 CONTROL SYSTEMS
15985 SEQUENCE OF OPERATION

DIVISION 16 - ELECTRICAL

16001 ELECTRICAL GENERAL PROVISIONS
16060 GROUNDING AND BONDING
16070 ELECTRICAL HANGERS AND SUPPORTS
16123 BUILDING WIRE AND CABLE
16129 GUTTERMELT ROOF- GUTTER HEAT TRACE SYSTEM
16130 RACEWAY AND BOXES
16140 WIRING DEVICES GENERAL
16210 ELECTRICAL UTILITY SERVICES
16265 ADJUSTABLE FREQUENCY DRIVES
16411 ENCLOSED SWITCHES
16421 ENCLOSED CONTROLLERS
16442 PANELBOARDS
16510 LED - INTERIOR LUMINAIRES
16520 LED - EXTERIOR LUMINAIRES
16721 FIRE DETECTION AND ALARM SYSTEMS
16740 TELEPHONE/DATA RACEWAY SYSTEMS

GEOTECHNICAL REPORT
A.L.T.A. SURVEY

SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PROJECT DESCRIPTION

A. The project consists of a new maintenance complex located in Hooper, UT. The following description is an outline of the work to be accomplished and not meant to be a definitive scope of work. Scope of work is defined by DFCM in their Request for Proposals for Design/Build Services documents:

1. The Work consists of construction of a new maintenance building, pivot gates, water retention and detention facilities. The Maintenance Building consists of a one-story structure with mezzanine, designed to store and provide facilities for the maintenance of vehicles. Installation of fixed equipment (provided as part of the work unless otherwise noted), utility connections and fees, excavation, grading and other site improvements are required as part of the work.

    a. The Work includes site preparation, excavation, concrete, building as selected by Design/Build team, architectural woodwork, waterproofing, hollow metal doors and frames, hardware, windows & glazing, interior finishes, plumbing, radiant tube floor heating, heating and ventilation systems.
    b. Interior finishing and related construction, including interior partitions and permanent doors, casework, equipment, and mechanical and electrical installations are required.
    c. Exterior work includes utilities, waste oil storage, site grading, retention and detention ponds, and other site work as defined in RFP.

1.3 CONTRACTOR USE OF PREMISES

A. General: During the construction period, the Contractor and subcontractors shall have use of the premises for construction operations. The use of the premises is limited only by the End User's right to perform construction operations with its own forces or to employ separate contractors on portions of the project.

1. Confine operations to areas within Contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.

2. Keep driveways and entrances serving the premises clear and available to the Owner and the Owner's employees at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

1.4 END USER OCCUPANCY

A. Partial Occupancy: The End User reserves the right to occupy and to place and install equipment in completed areas of the building, prior to Substantial Completion provided that such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.

B. Prior to End User occupancy, mechanical and electrical systems shall be fully operational. Required inspections and tests shall be successfully completed. Upon occupancy, the End User will provide operation and maintenance of mechanical and electrical systems in occupied portions of the building.

1.5 END USER CONSTRUCTED WORK

A. Coordinate with the Owner and Project Manager/General Contractor where construction in this contract interfaces with work performed by the End User.

B. Repair any damage to End User constructed items which occurs during the course of construction as a result of construction activity. Replace damaged items when repair is not possible to restore to the original undamaged condition or when required by Owner.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01010

SECTION 01027 - APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of 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 governing Applications for Payment submitted to Project Manager/General Contractor.
   1. Coordinate the Schedule of Values and Applications for Payment with the Construction Schedule and Submittal Schedule.

B. The Construction Schedule and Submittal Schedule are included in Section "Submittals".

1.3 SCHEDULE OF VALUES

A. Coordinate preparation of the Schedule of Values with preparation of the Contractors' Construction Schedule.

   1. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:
      a. Contractor's construction schedule.
      b. Application for Payment form.
      c. List of products.
      d. List of principal suppliers and fabricators.
      e. Schedule of submittals.

   2. Submit the Schedule of Values to the Project Manager/General Contractor at the earliest feasible date, but in no case later than 7 days before the date scheduled for submittal of the initial Application for Payment.

   3. Sub-Schedules: Where the Work is separated into phases that require separately phased payments, provide sub-schedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for the Schedule of Values.

   1. Identification: Include the following Project identification on the Schedule of Values:
      a. Project name and location.
      b. Project Manager/ General Contractor's name and address.
      c. Date of submittal.

   2. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:
      a. Generic name.
      b. Related Specification Section.
      c. Name of manufacturer or fabricator.
      d. Name of supplier.
      e. Change Orders (numbers) that have affected value.
      f. Dollar value.

3. Round amounts off to the nearest whole dollar; the total shall equal the subcontractor's Contract Sum.

4. For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

5. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT:

A. Each Application for Payment shall be consistent with previous applications and payments.

B. Payment Application Times: The date to submit initial application for payment is at the subcontractor's discretion, and subsequent applications for payment as set forth by the Project Manager/General Contractor but no later than 30 days thereafter.

C. Payment Application Format: Use format consistent with Schedule of Values.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.

2. Include amounts of Change Orders issued prior to the last day of the construction period covered by the application.

D. Transmittal: Submit 3 executed copies of each Application for Payment to the Project Manager/General Contractor by means ensuring receipt within 24 hours; one copy shall be complete, including waivers of lien and similar attachments, when required.

1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Project Manager/General Contractor.

E. Waivers of Mechanics Lien: With each Application for Payment submit waivers of mechanics liens from subcontractors or sub- subcontractors and suppliers for the construction period covered by the previous application.

1. Submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.

2. When an application shows completion of an item, submit final or full waivers.

3. The Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Waiver Delays: Submit each Application for Payment with the Contractor's waiver of mechanics lien for the period of construction covered by the application.
   a. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of Work covered by the application who could lawfully be entitled to a lien.

5. Waiver Forms: Submit waivers of lien on forms, and executed in a manner,

acceptable to Owner.

F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:

1. List of principal suppliers and fabricators.
2. Schedule of Values.
3. Schedule of principal products.
4. Submittal Schedule (preliminary if not final).
5. List of staff assignments.
6. Certificates of insurance and insurance policies as applicable.

G. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:

1. Completion of Project closeout requirements.
2. Completion of items specified for completion after Substantial Completion.
3. Assurance that unsettled claims will be settled.
4. Assurance that Work not complete and accepted will be completed without undue delay.
5. Transmittal of required Project construction records to Owner.
6. Proof that taxes, fees and similar obligations have been paid.
7. Removal of temporary facilities and services.
8. Removal of surplus materials, rubbish and similar elements.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01027

SECTION 01035 - MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of 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 for subcontractors for handling and processing Contract modifications to be submitted to Project Manager/General Contractor.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 1 Section "Application for Payment" for administrative procedures governing applications for payment.

2. Division 1 Section "Product Substitutions" for administrative procedures for handling requests for substitutions made after award of the Contract.

1.3 CHANGE ORDER PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Proposed changes in the Work that will require adjustment to the Contract Sum or Contract Time will be issued by the Project Manager/General Contractor, with a detailed description of the proposed change and supplemental or revised Drawings and Specifications, if necessary.

1. Proposal requests issued by the Project Manager/General Contractor are for information only. Do not consider them an instruction either to stop work in progress, or to execute the proposed change.

2. Unless otherwise indicated in the proposal request, within 15 days of receipt of the proposal request, submit to the Project Manager/General Contractor for review an estimate of cost necessary to execute the proposed change.

a. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

B. Subcontractor-Initiated Change Order Proposal Requests: When latent or other unforeseen conditions require modifications to the Contract, the subcontractor may propose changes by submitting a request for a change to the Project Manager/General Contractor.

1. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.

2. Include a list of quantities of products to be purchased and unit costs along with the

total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

C. Comply with requirements in Section "Product Substitutions" if the proposed change in the Work requires the substitution of one product or system for a product or system specified.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01035

SECTION 01040 - PROJECT COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of 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 supervisory requirements necessary for Project coordination including, but not necessarily limited to:

1. Coordination.
2. General installation provisions.
3. Cleaning and protection.

B. Field engineering is included in Section "Field Engineering".

C. Coordination meetings and pre-installation conferences are included in Section "Project Meetings".

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 to be submitted to Project Manager/General Contractor, outlining special procedures required for coordination.

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. Installation and removal of temporary facilities.

2. Delivery and processing of submittals.

3. Project Close-out activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

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, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.

1. Show the interrelationship of components shown on separate Shop Drawings.

2. Indicate required installation sequences.

3. Comply with requirements contained in Section "Submittals."

4. Refer to Division-15 Section "Basic Mechanical Requirements," and Division-16 Section "Basic Electrical Requirements" for specific coordination Drawing requirements for mechanical and electrical installations.

B. Staff Names: Within 15 days of Notice to Proceed, submit a list of principal staff assignments, including the trade Foreman and other personnel in attendance at the site; 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.

B. 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.

C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

D. Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.

E. 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 Architect for final decision.

F. Recheck measurements and dimensions, before starting each installation.

G. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

H. Coordinate temporary enclosures with required inspections and tests, to minimize the

necessity of uncovering completed construction for that purpose.

I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect 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 at Substantial Completion.

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, 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. Air contamination or pollution.
6. Water.
7. Solvents.
8. Chemicals.
9. Light.
10. Puncture.
11. Abrasion.
12. Heavy traffic.
13. Soiling, staining and corrosion.
14 Bacteria.
15. Rodent and insect infestation.
16. Combustion.
17. Electrical current.
18. High speed operation,
19. Improper lubrication,
20. Unusual wear or other misuse.
21. Contact between incompatible materials.
22. Destructive testing.
23. Misalignment.
24. Excessive weathering.
25. Unprotected storage.
26. Improper shipping or handling.
27. Theft.
28. Vandalism.

END OF SECTION 01040

SECTION 01050 - FIELD ENGINEERING

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. General: This Section specifies administrative and procedural requirements for field engineering services, including, but not necessarily limited to, the following:

1. Land survey Work.
2. Civil engineering services.
3. Structural engineering services.

1.3 SUBMITTALS

A. Certificates: Submit a certificate signed by the Land Surveyor or Professional Engineer certifying that the location and elevation of improvements comply with the Contract Documents.

B. Final Property Survey: Submit 6 copies of the final property survey, one reproducible copy, and the CAD files on CD;s. Software format as required by Owner.

C. Project Record Documents: Submit a record of Work performed and record survey data as required under provisions of Sections "Submittals" and "Project Closeout".

1.4 QUALITY ASSURANCE

A. Surveyor: Engage a Registered Land Surveyor registered in the State where the project is located, to perform land surveying services required.

B. Engineer: Engage a Professional Engineer of the discipline required, registered in the state in which the Project is located, to perform required engineering services.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing control points are noted on Contract Documents.

B. Verify layout information shown on the Drawings, in relation to the property survey and existing benchmarks before proceeding to layout 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. 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.

C. Establish and maintain a minimum of two 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.

D. Existing utilities and equipment: 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.

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. Working from lines and levels established by the property survey, establish benchmarks and markers to set lines and levels at each story of construction and elsewhere as needed to properly locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. 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. Surveyor's Log: Maintain a surveyor's log of control and other survey Work. Make this log available for reference.

1. Record deviations from required lines and levels, and advise the Architect when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted and not corrected.
2. On completion of foundation walls, major site improvements, and other Work requiring field engineering services, prepare a certified survey showing dimensions, locations, angles and elevations of construction and sitework.

C. Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means.

D. 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.

E. Existing Utilities: Furnish information necessary to adjust, move or relocate existing lines, services or other appurtenances located in, or affected by construction. Coordinate with local authorities having jurisdiction.

F. Final Property Survey: Before Substantial Completion, prepare a final property survey showing significant features (real property) for the Project. Include on the survey a certification, signed by the Surveyor, to the effect that principal metes, bounds, lines and levels of the Project are accurately positioned as shown on the survey.

END OF SECTION 01050

SECTION 01095 - REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. References to standards are incorporated into Project Manuel by reference and each reference is the latest edition at date shown on Contract Documents, including amendments and supplements.

1.2 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. Terms such as Ashown@, Anoted@, Ascheduled@, and Aspecified@ are used to help the reader locate the reference. There is no limitation on location.

C. Approved: When used in conjunction with the A/E=s action on the Contractor=s submittals, applications and requests Aapproval@ is limited to the Architect=s duties and responsibilities as stated in the General Conditions.

C. 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.

D. Furnish: The term furnish means supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations but not installation.

E. Install: The term install describes operations at the Project site including the actual unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

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

G. Installer: An Installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform 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. Trades: Using terms 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.
   2. Experienced: When used with the term Installer, requires 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.

H. Project site: is the space available to the Contractor for performing 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.

I. Testing Agencies: A testing agency 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.

K. Exposed: An item or surface, interior or exterior which is visible outside or inside building usable space, during building normal activity.

L. Including and such as: To be used in the most inclusive sense; example, Aincluding, but not necessarily limited to@, and Asuch as, but not necessarily limited to@.

M. Not-in Contact (NIC): Work not included in this contract.

N. Product: Material, equipment or system.

O. Reinstall: Operation involving existing materials and equipment, including handling, assembly, setting, placing, anchoring, protecting, cleaning and similar operations as applicable in each instance.

P. Remove: Disassemble, dismantle or demolish and transport away from Project site or Owners property.

Q. Salvage: Contractor shall dismantle existing materials or assemblies carefully, provide protection suitable for maintaining existing conditions of materials and store salvaged materials for re-installation or other use as directed by Owner.

R. Shown and indicated: Used as a cross reference to information on Drawings or Specifications elsewhere in project manual. No limitation of location is intended except as may be specifically noted.

S. Suitable Reasonable B Proper B Correct B Necessary: As stated for purpose intended by Contract Documents, subject to interpretation of Architect.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 16-Division format and MASTERFORMAT numbering system.

B. Specification Content: This Specification uses certain conventions regarding the style 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 abbreviated. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated, shall be interpolated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents 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, subjective language is used for clarity to

describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.

a. The words "shall be" are implied wherever a colon (:) is used within a sentence or phrase.

1.4 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 standards in effect as of the date of the Contract Documents.

C. Conflicting Requirements: Where compliance with two or more standards is specified and where the standards may establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different but apparently equal and other uncertainties to the Architect for a decision before proceeding.
General: In case of an inconsistency between Drawings and Specifications or within either Document not clarified specifically by the Architect; more specific provision will take precedence over less specific; more stringent will take precedence over less stringent. Better quality or greater quantity of Work shall be provided in compliance with Architect=s interpretation.

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 the requirements. Refer uncertainties to the Architect for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on the Project is required to 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, the Contractor shall obtain copies directly from the publication source.

E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. The following acronyms or abbreviations, as referenced in Contract Documents, are defined to mean the associated names. Names and addresses are subject to change and are believed, but not ensured, to be accurate and up to date as of the date of Contract Documents. The following is a partial list consisting of names most frequently used. For those not listed, refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.

AA Aluminum Association, 900 19th St., NW, Suite 300, Washington, DC 20006, (202) 862-5100

AABC Associated Air Balance Council, 1518 K St., NW, Washington, DC 20005, (202) 737-0202

AAMA American Architectural Manufacturers Assoc., 1540 E. Dundee Road, Suite 310, Palatine, IL 60067, (708) 202-1350

AASHTO American Association of State Highway, and Transportation Officials, 444 North Capitol St., Suite 225, Washington, DC 20001 (202) 624-5800

ACI American Concrete Institute, P.O. Box 19150, Detroit, MI 48219 (313) 532-2600

ACPA American Concrete Pipe Assoc. , 8300 Boone Blvd., Suite 400, Vienna, VA 22182 (703) 821-1990

ADC Air Diffusion Council, One Illinois Center, Suite 200, 11 East Wacker Drive, Chicago, IL 60601-4298,(312) 616-0800

AI Asphalt Institute, Research Park Drive, P.O. Box 14052, Lexington, KY 40512-4052, (606) 288-4960

AIA American Institute of Architects, 1735 New York Ave., NW, Washington, DC 20006 (202) 626-7300

AISC American Institute of Steel Construction, One East Wacker Drive, Suite 3100, Chicago, IL 60601-2001 (312) 670-2400

AISI American Iron and Steel Institute, 1101 17th Street, NW, Suite 1300, Washington, DC 20036-4700, (202) 463-6573

ALSC American Lumber Standards Committee, P.O. Box 210, Germantown, MD 20875, (301) 972-1700

AMCA Air Movement and Control Assoc., 30 W. University Drive, Arlington Heights, IL 60004-1893, (708) 394-0150

ANSI American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY, 0036, (212) 642-4900

APA American Plywood Assoc., P.O. Box 11700, Tacoma, WA 98411, (206) 565-6600

ARI Air Conditioning and Refrigeration Institute, 1501 Wilson Blvd., 6th Floor, Arlington, VA 22209, (703) 524-8800

ASA Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797 (516) 349-7800

ASC Adhesive and Sealant Council, 1627 K Street, NW, Suite 1000, Washington, DC 20006-1707, (202) 452-1500

ASHRAE American Society of Heating, Refrigerating, and Air-Conditioning Engineers, 1791 Tullie, Circle, NE, Atlanta, GA 30329, (404) 636-8400

ASME American Society of Mechanical Engineers, 345 East 47th St., New York, NY 10017 (212) 705-7722

ASPE American Society of Plumbing Engineers, 3617 Thousand Oaks Blvd., Suite 210, Westlake, CA 91362, (805) 495-7120

ASSE American Society of Sanitary Engineering, P.O. Box 40362, Bay Village, OH 44140 (216) 835-3040

ASTM American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103-1187, (215) 977-9679

AWI Architectural Woodwork Institute, P.O. Box 1550, 13924 Braddock Rd., Suite 100, Centreville, VA 22020 , (703) 222-1100

AWPA American Wood-Preservers' Assoc., 4128-1/2 California Ave. SW, No. 171, Seattle, WA 98116, (206) 937-5338

AWPB American Wood Preservers Bureau, 4 E. Washington St., Newnan, GA 30263, (404) 254-9877

AWS American Welding Society, 550 LeJeune Road, NW, P.O. Box 351040, Miami, FL 33135, (305) 443-9353

AWWA American Water Works Assoc., 6666 W. Quincy Ave., Denver, CO 80235, (303) 794-7711

BHMA Builders' Hardware Manufacturers Assoc., 355 Lexington Ave., 17th Flr, New York, NY 10017, (212) 661-4261

CISPI Cast Iron Soil Pipe Institute, 5959 Shallowford Road, Suite 419, Chattanooga, TN 37421, 615) 892-0137

CRS Concrete Reinforcing Steel Institute, 933 Plum Grove Rd., Schaumburg, IL 60173, (708) 517-1200

CTI Ceramic Tile Institute of America, 700 N. Virgil Ave., Los Angeles, CA 90029, (213) 660-1911

DHI Door and Hardware Institute, 14170 New Brook Drive, Chantilly, VA 22022, (703) 222-2010

DLPA Decorative Laminate Products Assoc., 600 S. Federal St., Suite 400, Chicago, IL 60605, (312) 922-6222

EIA Electronic Industries Assoc., 2001 Pennsylvania Ave., NW, Washington, DC 20006-1813, (202) 457-4900

EJMA Expansion Joint Manufacturers Assoc., 25 N. Broadway, Tarrytown, NY 10591, (914) 332-0040

FGMA Flat Glass Marketing Assoc., White Lakes Professional Bldg., 3310 S.W. Harrison, Topeka, KS 66611-2279, (913) 266-7013

FM Factory Mutual Research Organization, 1151 Boston-Providence Turnpike, P.O. Box 9102, Norwood, MA 02062, (617) 762-4300

GA Gypsum Association, 810 First Street, NE, Suite 510, Washington, DC 20002 (202) 289-5440

HMA Hardwood Manufacturers Assoc., 400 Penn Center Blvd., Pittsburgh, PA 15235, (412) 829-0770

HPMA Hardwood Plywood Manufacturers Assoc., 1825 Michael Farraday Drive, P.O. Box 2789 Reston, VA 22090-2789 (703) 435-2900

ICEA Insulated Cable Engineers Association, Inc., P.O. Box 440, South Yarmouth, MA 02664 (508) 394-4424

IEC International Electrotechnical Commission, (Available from ANSI), 1430 Broadway, New York, NY 10018, (212) 354-3300

IEEE Institute of Electrical and Electronic Engineers, 345 E. 47th St., New York, NY 10017 (212) 705-7900

IESNA Illuminating Engineering Society of North America, 345 E. 47th St., New York, NY 10017 (212) 705-7926

IGCC Insulating Glass Certification Council, c/o ETL Testing Laboratories, Inc., P.O. Box 2040, Route 11, Industrial Park, Cortland, NY 13045,(607) 753-6711

ISA Instrument Society of America, P.O. Box 12277, 67 Alexander Drive, Research Triangle Park, NC 27709, (919) 549-8411

LPI Lightning Protection Institute, 365 North Arlington Heights Rd., Suite J, Arlington Heights, IL 60004, (708) 255-3003

MBMA Metal Building Manufacturer's Assoc., c/o Charles M. Stockinger, Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851, (216) 241-7333

NAAMM National Association of Architectural Metal Manufacturers, 600 S. Federal St., Suite 400 Chicago, IL 60605, (312) 922-6222

NAIMA North American Insulation Manufacturers Assoc., 44 Canal Center Plaza, Suite 310, Alexandria, VA 22314 (703) 684-0084

NAPA National Asphalt Pavement Assoc., NAPA Building, 5100 Forbes Blvd., Lanham, MD 20706-4413, (301) 731-4748

NCMA National Concrete Masonry Assoc., P.O. Box 781, Herndon, VA 22070-0781 (703) 435-4900

NEC National Electrical Code (from NFPA)

NECA National Electrical Contractors Assoc., 7315 Wisconsin Ave., Bethesda, MD 20814 (301) 657-3110

NEMA National Electrical Manufacturers Assoc., 2101 L St., NW, Suite 300, Washington, DC 20037, (202) 457-8400

NETA International Electrical Testing Assoc., P.O. Box 687, Morrison, CO 80465, (303) 467-0526

NFPA National Fire Protection Assoc., One Batterymarch Park, P.O. Box 9101, Quincy, MA , 2269-9101, (617) 770-3000, (800) 344-3555

N.F.P.A. National Forest Products Assoc., 1250 Connecticut Ave., NW, Suite 200, Washington, DC 20036, (202) 463-2700

NLGA National Lumber Grades Authority, 1055 W. Hastings St., Suite 260, Vancouver, British Columbia, Canada V6E 2E9 (604) 687-2171

NPA National Particleboard Assoc., 18928 Premiere Court, Gaithersburg, MD 20879, (301) 670-0604

NRCA National Roofing Contractors Assoc., 10255 W. Higgins Rd., Suite 600, Rosemont, IL , 60018-5607, (708) 299-9070

NSF National Sanitation Foundation, 3475 Plymouth Rd. P.O. Box 1468, Ann Arbor, MI 48106, (313) 769-8010

PCA Portland Cement Assoc., 5420 Old Orchard Road, Skokie, IL 60077, (708) 966-6200

RFCI Resilient Floor Covering Institute, 966 Hungerford Drive, Suite 12-B, Rockville, MD 20805, (301) 340-8580

RMA Rubber Manufacturers Assoc., 1400 K St., NW, Washington DC 20005, (202) 682-4800

SDI Steel Deck Institute, P.O. Box 9506, Canton, OH 44711 (216) 493-7886

S.D.I. Steel Door Institute, 30200 Detroit Road, Cleveland, OH 44145 (216) 889-0010

SGCC Safety Glazing Certification Council c/o ETL Testing Laboratories, Route 11, Industrial Park Cortland, NY 13045, (607) 753-6711

SIGMA Sealed Insulating Glass Manufacturers Assoc., 401 N. Michigan, Chicago, IL 60611, (312) 644-6610

SJI Steel Joist Institute, 1205 48th Avenue North, Suite A, Myrtle Beach, SC 29577 (803) 449-0487

SMACNA Sheet Metal and Air Conditioning, Contractors National Association, 4201 Lafayette Center Dr. Chantilly, VA 22021, (703) 803-2980

SSPC Steel Structures Painting Council, 4400 Fifth Ave., Pittsburgh, PA 15213-2683, (412) 268-3327

TCA Tile Council of America, P.O. Box 326, Princeton, NJ 08542, (609) 921-7050

TIMA Thermal Insulation Manufacturers Assoc., 29 Bank Street, Stamford, CT 06901, (203) 324-7533 (Standards now issued by NAIMA)

UL Underwriters Laboratories, Inc., 333 Pfingsten Rd., Northbrook, IL 60062, (708) 272-8800\
WCLIB West Coast Lumber Inspection Bureau, P.O. Box 23145, Portland, OR 97223 , (503) 639-0651

WRI Wire Reinforcement Institute, 1101 Connecticut Ave. NW, Suite 700, Washington, DC , 20036-4303, (202) 429-5125

WSC Water Systems Council, 600 S. Federal St., Suite 400, Chicago, IL 60605, (312) 922-6222

WWPA Western Wood Products Assoc., Yeon Building, 522 SW 5th Avenue, Portland, OR 97204-212 (503) 224-3930

W.W.P.A. Woven Wire Products Assoc., 2515 N. Nordica Ave., Chicago, IL 60635, (312) 637-1359

F. Federal Government Agencies: Names and titles of federal government standard- or Specification-producing agencies are often abbreviated. The following acronyms or abbreviations referenced in the Contract Documents indicate names of standard- or Specification-producing agencies of the federal government. Names and addresses are subject to change but are believed to be, but are not assured to be, accurate and up to date as of the date of the Contract Documents.

CFR Code of Federal Regulations, (Available from the Government Printing Office), N. Capitol St. between G and H St. NW, Washington, DC 20402 (202) 783-3238,
(Material is usually first published in the "Federal Register")

CPSC Consumer Product Safety Commission, 5401 Westbard Ave., Bethesda, MD 20207, (301) 492-6580, (800) 638-2772

DOC U.S. Department of Commerce, 14th St. and Constitution Ave., NW, Washington, DC 20230 (202) 482-2000

DOT Department of Transportation, 400 Seventh St., SW, Washington, DC 20590, (202) 366-4000

EPA Environmental Protection Agency, 401 M St., SW, Washington, DC 20460, (202) 382-2090

FCC Federal Communications Commission, 1919 M St., NW, Washington, DC 20554 (202) 632-7000

FS Federal Specification (from GSA), Specifications Unit (WFSIS), 7th and D St., SW, Washington, DC 20407 (202) 708-9205

GSA General Services Administration, , F St. and 18th St., NW, Washington, DC 20405, (202) 708-5082

NIST National Institute of Standards and Technology, (U.S. Department of Commerce), Gaithersburg, MD 20899, (301) 975-2000

OSHA Occupational Safety and Health Administration, (U.S. Department of Labor), N3647, 200 Constitution Ave., NW, Washington, DC 20210, (202) 219-8148

USDA U.S. Department of Agriculture, 14th St. and Independence Ave., SW, Washington, DC 20250 (202) 447-2791

1.5 SUBMITTALS

A. Permits, Licenses, and Certificates: For the Owner's and End User=s records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01095

SECTION 01096 - MATERIAL KEYNOTE LEGEND

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 EXAMPLES

A. Examples used herein are for illustrative purposes only, the keynote, notes and descriptions do not necessarily correspond to those used on the drawings.

1.3 KEYNOTE EXPLANATION AND FORMAT

A. Keynote Explanation: The Architectural Drawings utilize a keynoting system which references the keynote to the 5-digit specification section in which the item is specified. Such reference is for keynote clarity and organization; and does not restrict or control the Contractor in dividing the Work among subcontractors or in establishing the extent of Work to be performed by any trade.

B. Keynote Format: The keynote system uses a format which includes an alphanumeric designation connected to the material or product through the Keynote Legends on the drawings.

1. Example: **06105.R6** is the keynote placed on the drawings (plan, elevation, section, detail). The Material Keynote Legend identifies the material as Exterior Grade Plywood. The first five characters of keynote **06105.R6** reference Section 06105, Miscellaneous Carpentry, which is the section the plywood is specified. The next 2 characters off keynote **06105.R6** are an abbreviated alpha/numeric characters used to distinguish this plywood from other materials specified in Section 06105 and does not reference any specific paragraph within the specification section.

C. Keynote Qualifiers: Many keynotes are qualified by information placed in parentheses following the keynote. The type of information is indicated on the Material Keynote Legend and includes, but is not limited to, the following: SIZE, SPACING, THICKNESS, GAGE, WEIGHT, and FINISH. Information is presented in this format to reduce the complexity of the keynoting system.

1. Example: **06105.R6 (5/8”)** is a keynote placed on the drawings. The Material Keynote Legend identifies the material as Exterior Grade Plywood (thickness). Alphanumeric characters, such as .R6 in this example, are used to group similar materials, products, and systems. The qualifier, (thickness), in the keynote description indicates information which further clarifies the material or product, and is found on the drawing following the keynote. In this example, the keynote requires 5/8” exterior grade plywood be provided.

2. Keynote descriptions which indicate a qualifier do not always have the qualifying information placed adjacent the keynote on the drawing, but remain valid keynotes. Where the qualifier is not included, the information is to be found elsewhere on the drawings or in the specifications.

1.4 GENERAL NOTES AND NOTES

A. Project General Notes: Notes on the drawings related to the entire project are organized by discipline: Civil, Architectural, Structural, Mechanical, Electrical, etc. and are placed at or near the front of each section of the drawings under the heading PROJECT GENERAL NOTES.

1. Example:
   1. Unless noted otherwise, dimensioning on plans is to face of studs (F.O.S.).
   2. Contractor to verify all dimensioning and conditions at site.

B. General Notes: Notes that are specific to individual sheets within the set of drawings are referred to as GENERAL NOTES and listed in the title block below the Material Keynote Legend. These notes are often used to reference and facilitate the process of finding the information.

1. Example:
   1. See: AE500 for Wall Types.
   2. See: AE601 for Door Schedule.

C. Notes: Notes that are specific to a drawing (plan, elevation, section, detail, etc.) are referred to as NOTES and are located in the title block under the Material Keynote Legend and/or the General Notes. This type of note is used to further clarify a specific drawing on the sheet and is indicated on the actual drawing as NOTE followed by a number with a leader drawn to the applicable location.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01096

SECTION 01200 - PROJECT MEETINGS

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 for project meetings including but not limited to:

1. Pre-Construction Conference.
2. Coordination Meetings.

B. Construction schedules are specified in another Division-1 Section.

1.3 PRE-CONSTRUCTION CONFERENCE

A. Attend a pre-construction conference and organizational meeting, scheduled by Owner, at the project site or other convenient location no later than 5 days after execution of the Agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.

B. Attendees: The Owner, Project Manager/General Contractor, Architect and their consultants, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

C. Proposed Agenda: Parties attending the Pre-Construction Meeting shall be familiar with the project to discuss items of significance that could affect progress including such topics as:

1. Tentative construction schedule.
2. Critical Work sequencing.
3. Designation of responsible personnel.
4. Procedures for processing field decisions and Change Orders.
5. Procedures for processing Applications for Payment.
6. Distribution of Contract Documents.
7. Submittal of Shop Drawings, Product Data and Samples.
8. Preparation of record documents.
9. Use of the premises.
10. Office, Work and storage areas.
11. Equipment deliveries and priorities.
12. Safety procedures.
13. First aid.
14. Security.
15. Housekeeping.
16. Working hours.

1.4 SUBCONTRACTOR COORDINATION MEETINGS

A. Participation in project coordination meetings is required. Meeting shall be held at regularly scheduled times convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.

B. Project Manager/General Contractor will notify applicable subcontractor for representation at coordination meetings.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01200

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of 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 for submittals required for performance of the Work, including;

1. Submittal procedures.
2. Shop Drawings.
3. Product Data.
4. Samples.

B. Administrative Submittals: Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:

1. Permits.
2. Applications for payment.
3. Insurance certificates.

C. The Schedule of Values submittal is included in Section "Applications for Payment."

D. Inspection and test reports are included in Section "Quality Control Services."

1.3 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

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 elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

a. The Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

3. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for re-submittals.

a. Allow ten working days for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Architect will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
b. If an intermediate submittal is necessary, process the same as the initial submittal.

c. Allow ten working days for reprocessing each submittal.
d. If a second or third person needs to review the submittal, Allow ten working days for each discipline or agency required for review.
e. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the work to allow for required processing time.

B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.

2. Include the following information on the label for processing and recording action taken.

a. Project name.
b. Date.
c. Name and address of Architect.
d. Name and address of Contractor.
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.

C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.

1. Identify each submittal with a submittal number consisting of a chronological submittal number followed by the Specification Section number and an alphabetical submission designation letter. Designate initial submission with an "A". Example: 2-03300-A indicates second submittal for the project, item submitted is in section 03300, and it is the first submittal for the item.

2. On the transmittal record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

3. Indicate required return date on transmittal form. For submittals needed prior to allotted review period specified above, mark clearly on transmittal form: "URGENT" and indicate return date.

4. Transmittal Form: Use the sample form at the end of this Section for transmittal of submittals.

D. Re-submittals: Indicate original submittal number with letter designation in alphabetical order for each re-submittal. "B" for first re-submittal, "C" for second re-submittal and so forth.

1.4 SHOP DRAWINGS

D. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise

indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

E. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:

1. Dimensions.
2. Identification of products and materials included.
3. Compliance with specified standards.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.
6. Sheet Size: Except for templates, patterns and similar full- size Drawings, submit Shop Drawings on 8-1/2" x 11", 11" X 17", or 24" x 36" sheets.
   a. One of the prints returned shall be marked-up and maintained as a "Record Document"
7. Number of Copies: Submit 4 opaque (bond) copies of each submittal. Architect will return two copies.
8. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

1.5 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."

1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:

   a. Manufacturer's printed recommendations.
   b. Compliance with recognized trade association standards.
   c. Compliance with recognized testing agency standards.
   d. Application of testing agency labels and seals.
   e. Notation of dimensions verified by field measurement.
   f. Notation of coordination requirements.

2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

3. Submittals: Submit 5 copies of each required submittal. The Architect will retain 1, and will return the other copies marked with action taken and corrections or modifications required.

4. Distribution: Furnish copies of reviewed submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.

   a. Do not proceed with installation until an applicable copy of Product Data applicable is in the installer's possession.
   b. Do not permit use of unmarked copies of Product Data in connection with construction.

B. Project Submittal Schedule: As required by the individual Specification Sections, prepare a written summary submittal schedule indicating types of products or processes and submittals required for the Work and their intended timely delivery times to the Architect within the duration of construction. Effort shall be made to stagger the submittals so they can be reasonably processed by the Architect in a manner that follows the construction procurement requirements.

1. Number of copies: Submit three copies of product schedule or list, unless otherwise indicated. Architect will return two copies.

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of appropriate Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

4. Samples for initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patters available.

   a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return one submittal with options selected and retain the other.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture and pattern; color range sets; and components used for independent testing and inspection.

   a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample set; remainder will be returned.

1.6 ARCHITECT'S ACTION

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect will review each submittal, mark to indicate action taken, and return promptly.

1. Compliance with specified characteristics is the Contractor's responsibility.

B. Action Stamp: The Architect will stamp each submittal with a uniform, self-explanatory action

stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

1. Final Unrestricted Release: Where submittals are marked **"Reviewed, no exceptions noted,"** that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.

2. Final-But-Restricted Release: When submittals are marked **"Reviewed, exceptions noted,"** that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.

    a. When marked **"Resubmission required,"** resubmission is for record, clarification, or for purposes of confirming the information contained in the submittal. The submittal shall be considered as not acceptable until such time as the written response is accepted by the Architect.

    b. When marked **"Resubmission not required**," no further submittal action is required.

3. Returned for Re-submittal: When submittal is marked **"Rejected, resubmission required,"** do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.

    a. Do not permit submittals marked **"Rejected, re-submittal required"** to be used at the Project site, or elsewhere where Work is in progress.

4. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "information received – no review required."

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION 01300

CONTRACTOR SUBMITTAL FORM

CONTRACTOR:
ADDRESS:

PROJECT: UDOT Maintenance Station #1421
Hooper, Utah

SUBMITTAL NO: _____

TO: Architectural Firm
Address
Address

DATE: _____

Architect Project No. XXXX.XX

ATTN: Architect Representative

No. of Copies	**Description**	**Source** (Mfg., Supplier, Subcontractor)	**Spec. Section or Drawing Reference**

Remarks:

_____

_____

_____

_____

_____

Signature of the General Contractor certifies that the material or equipment contained in this submittal has been checked for compliance with the Contract Documents, and that dimensions have been checked.

_____
Signature

SECTION 01400 - QUALITY CONTROL SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of 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 for quality control services.

B. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the 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.

2. Inspections, test and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.

3. Requirements for the Contractor to provide quality control services required by the Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 RESPONSIBILITIES

A. Owner Responsibilities: The Owner will provide inspections, tests and similar quality control services, specified in individual Specification Sections and required by governing authorities, except where they are specifically indicated to be the Contractor's responsibility.

1. The Owner will engage and pay for the services of an independent agency to perform inspections and tests specified as the Owner's responsibility.

a. Where the Owner has engaged a testing agency or other entity for testing and inspection of a part of the Work, and the Contractor is also required to engage an entity for the same or related element, the Contractor shall not employ the entity engaged by the Owner, unless otherwise agreed in writing with the Owner.

2. Retesting: The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance with Contract Document requirements, regardless of whether the original

test was the Contractor's responsibility.

a. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.

3. Associated Services: The Contractor shall 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:

a. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
b. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
c. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
d. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
e. Security and protection of samples and test equipment at the Project site.

B. Owner Responsibilities: The Owner will provide inspections, tests and similar quality control services specified to be performed by independent agencies and not by the Contractor, except where they are specifically indicated as the Contractor's responsibility or are provided by another identified entity.

1. The Owner will employ and pay for the services of an independent agency, testing laboratory or other qualified firm to perform services which are the Owner's responsibility.

C. Duties of the Testing Agency: The independent testing agency engaged to perform inspections, sampling and testing of materials and construction specified in individual Specification Sections shall cooperate with the Architect and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.

1. The agency shall notify the Architect 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 not perform any duties of the Contractor.

D. 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.

2. Contractor will be responsible for ordering tests on a timely basis. Delays in the work caused by Contractors failure to order testing on time or to make corrections due to faulty materials or installation for retesting will not be allowed as a basis for

extending the contract time.

1.4 SUBMITTALS

A. The independent testing agency shall submit an Owner certified written report of each inspection, test or similar service, to the Owner & Architect, in duplicate, unless the Contractor is responsible for the service. If the Contractor is responsible for the service, submit a certified written report of each inspection, test or similar service through the Contractor, in duplicate.

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. Submittals List of required testing: Submit a list of tests to be provided as required by the Specifications or Drawings.

1.5 QUALITY ASSURANCE

A. Qualification for Service Agencies: For testing which is not the specific responsibility of the Owner, engage inspection and testing service agencies, including independent testing laboratories, which are pre-qualified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.

1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State of Utah.

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 to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with Contract Document

requirements for "Cutting and Patching."

B. Protect construction exposed by or for quality control service activities, and protect repaired construction.

C. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION 01400

SECTION 01500 - TEMPORARY FACILITIES

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 requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

B. Temporary utilities required include but are not limited to:

1. Water service and distribution.
2. Temporary electric power and light.
3. Telephone service and fax.

C. Temporary construction and support facilities required include but are not limited to:

1. Field office and storage sheds.
2. Sanitary facilities, including drinking water.
3. Dewatering facilities and drains.
4. Temporary project identification signs and bulletin boards.
5. Waste disposal services.
6. Construction aids and miscellaneous services and facilities.

D. Security and protection facilities required include but are not limited to:

1. Barricades, warning signs, lights.
2. Enclosure fence around buildings.
3. Environmental protection.

1.3 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:

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 Code 241, "Building Construction and Demolition Operations", ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition", and NECA Electrical Design Library "Temporary Electrical Facilities."

1. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", prepared jointly by AGC and ASC, for industry recommendations.
2. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NFPA 70).

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 Owner, change over from use of temporary service to use of the permanent service.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials; if acceptable to the Architect, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.

B. Lumber and Plywood: Comply with requirements in Division-6 Section "Rough Carpentry."

1. For job-built temporary sheds within the construction area, provide UL labeled, fire treated lumber and plywood for framing, sheathing and siding.
2. For signs and directory boards, provide exterior type, Grade B-B High Density Concrete Form Overlay Plywood conforming to PS-1, of sizes and thickness indicated.
3. For safety barriers and similar uses, provide minimum 5/8" thick exterior plywood.

C. Roofing Materials: Provide UL Class "A" standard weight asphalt shingles complying with ASTM D3018, or UL Class "C" mineral surfaced roll roofing complying with ASTM D 249 on roofs of job-built temporary offices, shops and sheds.

D. Paint: Comply with requirements of Division 9 Section "Finish Painting."

1. For sign panels and applying graphics, provide exterior grade alkyd gloss enamel over exterior primer.

E. Tarpaulins: Provide waterproof, fire-resistant, UL labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures provide translucent nylon reinforced laminated polyethylene or polyvinyl chloride fire retardant tarpaulins.

F. Water: Provide potable water approved by local health authorities.

2.2 EQUIPMENT

A. General: Provide new equipment; if acceptable to the Architect, undamaged, previously used

equipment in serviceable condition may be used. Provide equipment suitable for use intended.

B. Water Hoses: Provide 3/4" heavy duty, abrasion resistant, flexible rubber hoses 100 ft. long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shut-off nozzles at hose discharge.

C. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.

D. Electrical Power Cords: Provide grounded extension cords; use "hard service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.

E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.

F. Temporary Offices: Provide mobile unit (trailer) with lockable entrances, operable windows, and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.

G. Temporary Toilet Units: Provide self contained single occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material.

H. First Aid Supplies: Comply with governing regulations.

I. 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 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 install temporary service or connect to existing service. Where the company provides only part of the service, provide the

remainder with matching, compatible materials and equipment; comply with the company's recommendations.

1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.
2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked in services.
3. Obtain easements to bring temporary utilities to the site, where the Owner's easements cannot be used for that purpose.
4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Architect, and will not be accepted as a basis of claims for a Change Order.

B. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction using permanent water service on-site.

1. Sterilization: Sterilize temporary water piping prior to 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 or earlier if existing service is available. Include meters, transformers, overload protected disconnects, automatic ground fault interrupters and main distribution switch gear.

1. Except where overhead service must be used, install electric power service underground.
2. Power Distribution System: Install wiring overhead, and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, AC 20 ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.

D. Temporary Lighting: Whenever overhead floor or roof deck has been installed, provide temporary lighting with local switching.

1. Install and operate temporary lighting that will fulfill security and protection requirements, without operating the entire system, and will provide adequate illumination for construction operations and traffic conditions.

E. Temporary Telephones: Provide temporary telephone service for all personnel engaged in construction activities, throughout the construction period. Install telephone on a separate line for each temporary office and first aid station. Where an office has more than two occupants, install a telephone for each additional occupant or pair of occupants.

1. At each telephone, post a list of important telephone numbers.

3.3 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

A. Locate field offices, storage sheds, sanitary facilities and other temporary construction and support facilities for easy access.

1. Maintain temporary construction and 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 Owner.

B. Provide incombustible construction for offices, shops and sheds located within the

construction area, or within 30 feet of building lines. Comply with requirements of NFPA 241.

C. Field Offices: Provide insulated, weathertight temporary offices of sufficient size to accommodate required office personnel at the Project site. Keep the office clean and orderly for use for small progress meetings. Furnish and equip offices as follows:

1. Furnish with a desk and chairs (for 8-10 persons), plan table and plan rack.

D. Storage and Fabrication Sheds: Install storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere on the site.

E. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.

1. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.

F. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit type privies will not be permitted.

G. Drinking Water Facilities: Provide containerized tap dispenser bottled water type drinking water units, including paper supply.

1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F (7 to 13 deg C).

H. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, provide dewatering procedures, temporary trenches and field drains as needed to maintain the site, excavations and construction free of water.

I. Temporary Enclosures: Provide temporary enclosure for protection of construction in progress and completed, from exposure, foul weather, other construction operations and similar activities.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 square feet or less with plywood or similar materials.

3. Close openings through floor or roof decks and horizontal surfaces with load-bearing wood-framed construction.

J. Temporary Exterior Lighting: Install exterior yard and sign lights so that signs are visible when Work is being performed.

K. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal

weather or 3 days when the temperature is expected to rise above 80 deg F (27 deg C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

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 Architect.

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."

1. Locate fire extinguishers where convenient and effective for their intended purpose, but 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 fighting fires. Prohibit smoking in hazardous fire exposure areas.

4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

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. 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. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

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 freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour day basis where required to achieve indicated results and to avoid possibility of damage.

2. Protection: Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Architect requests that it be maintained longer,

remove each temporary facility when the need has ended, or when 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 the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.

2. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:
   a. Replace air filters and clean inside of ductwork and housings.
   b. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
   c. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION 01500

SECTION 01600 - MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of 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 governing the Contractor's selection of products for use in the Project.

B. The Contractor's Construction Schedule and the Schedule of Submittals are included under Section "Submittals."

C. Standards: Refer to Section "Definitions and Standards" for applicability of industry standards to products specified.

D. Administrative procedures for handling requests for substitutions made after award of the Contract are included under Section "Product Substitutions."

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 such 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.

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.

1. When specified products are available only from sources that do not or cannot produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect for a determination of the most important product qualities before proceeding. Qualities may include attributes relating to visual appearance, strength, durability, or compatibility. When a determination has been made, select

products from sources that produce products that possess these qualities, to the fullest extent possible.

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.

C. 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 weathertight 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, not by previous project experience. Procedures governing product selection include the following:

1. 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 concerning "substitutions" to obtain approval for use of an unnamed product.

2. 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.

3. 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.

4. 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.

5. 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.

6. Visual Matching: Where Specifications require matching an established Sample, the Architect'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.

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 01600

SECTION 01631 - PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of 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 for handling requests for substitutions made after award of the Contract.

B. The Contractor's Construction Schedule and the Schedule of Submittals are included under Section "Submittals."

C. Standards: Refer to Section "Definitions and Standards" for applicability of industry standards to products specified.

D. Procedural requirements governing the Contractor's selection of products and product options are included under Section "Materials and Equipment."

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions." The following are not considered substitutions:

1. Substitutions requested by Bidders during the bidding period, and accepted prior to award of Contract, are considered as included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
2. Revisions to Contract Documents requested by the Owner or Architect.
3. Specified options of products and construction methods included in Contract Documents.
4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.4 SUBMITTALS

A. Substitution Request Submittal: Requests for substitution will be considered if received within 10 days after commencement of the Work. Requests received more than 10 days after commencement of the Work may be considered or rejected at the discretion of the Architect.

1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and in accordance with procedures required for Change Order proposals.

2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions,

and the following information, as appropriate:

a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
b. Samples, where applicable or requested.
c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors, that will become necessary to accommodate the proposed substitution.
e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
f. Cost information, including a proposal of the net change, if any in the Contract Sum.
g. Certification by the Contractor that the substitution proposed is equal to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time, that may subsequently become necessary because of the failure of the substitution to perform adequately.

3. Architect's Action: Within one week of receipt of the request for substitution, the Architect will request additional information or documentation necessary for evaluation of the request. Within one weeks of receipt of the request, or one week of receipt of the additional information or documentation, whichever is later, the Architect will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name. Acceptance will be in the form of a Change Order.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Conditions: The Contractor's substitution request will be received and considered by the Architect when one or more of the following conditions are satisfied, as determined by the Architect; otherwise requests will be returned without action except to record noncompliance with these requirements.

1. Extensive revisions to Contract Documents are not required.

2. Proposed changes are in keeping with the general intent of Contract Documents.

3. The request is timely, fully documented and properly submitted.

4. The request is directly related to an "or equal" clause or similar language in the Contract Documents.

5. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities

properly.

6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

7. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

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 provide the required warranty.

B. The Contractor's submittal and Architect's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01631

SECTION 01700 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of 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 for project closeout, including but not limited to:

1. Inspection procedures.
2. Project record document submittal.
3. Operating and maintenance manual submittal.
4. Submittal of warranties.
5. Final cleaning.

B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions-2 through -16.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.

2. Advise Owner of pending insurance change-over requirements.

3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.

4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.

5. Submit record drawings, maintenance manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.

6. Deliver tools, spare parts, extra stock, and similar items.

7. Make final change-over of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of change-over in security provisions.

8. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities

from the site, along with construction tools, mock-ups, and similar elements.

9. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

B. Inspection Procedures: On receipt of a request for inspection, the Architect will either proceed with inspection or advise the Contractor of unfilled requirements. The Architect will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

1. The Architect will repeat inspection when requested and assured that the Work has been substantially completed.

2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

3. Submit a certified copy of the Architect's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Architect.

4. Submit final meter readings for utilities and similar data as of the date of Substantial Completion, or when the Owner took possession of and responsibility for corresponding elements of the Work.

5. Submit consent of surety to final payment.

6. Submit a final liquidated damages settlement statement.

7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Re-inspection Procedure: The Architect will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Architect.

1. Upon completion of re-inspection, the Architect will prepare a certificate of final acceptance, or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
2. If necessary, re-inspection will be repeated.

1.5 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposes; protect from deterioration

and loss in a secure, fire-resistive location; provide access to record documents for the Architect's reference during normal working hours.

B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract 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 Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.

2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.

3. Note related Change Order numbers where applicable.

4. 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.

C. Record Specifications: Maintain one complete copy of the Project Manual, 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.

1. Upon completion of the Work, submit record Specifications to the Architect for the Owner's records.

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. Note related Change Orders and mark-up of record drawings and Specifications.

1. Upon completion of mark-up, submit complete set of record Product Data to the Architect for the Owner's records.

E. Record Sample Submitted: Immediately prior to the date or dates of Substantial Completion, the Contractor will meet at the site with the Architect and the Owner's personnel to determine which of the submitted Samples that have been maintained during progress of the Work are to be transmitted to the Owner for record purposes. Comply with delivery to the Owner's Sample storage area.

F. Miscellaneous Record Submittals: Refer to other Specification Sections 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 Architect for the Owner's records.

G. Maintenance Manuals: Provide 5 CD'S of O&M manuals as describe in Specification 15000.1.7. Also provide 2 hard copies of O&M manuals. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:

1. Emergency instructions.
2. Spare parts list.
3. Copies of warranties.
4. Wiring diagrams.
5. Recommended "turn around" cycles.
6. Inspection procedures.
7. Shop Drawings and Product Data.
8. Fixture lamping schedule.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner'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. Identification systems.
7. Control sequences.
8. Hazards.
9. Cleaning.
10. Warranties and bonds.
11. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start-up.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

3.2 FINAL CLEANING

A. General: General cleaning during construction is required by the General Conditions and included in Section "Temporary Facilities".

B. Cleaning: Employ experienced workers or professional cleaners 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.

1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.

a. Remove labels that are not permanent labels.
b. 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.
c. 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.
d. 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.
e. 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.

C. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

D. 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 Owner'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 Owner's property, arrange for disposition of these materials as directed.

END OF SECTION 01700

SECTION 01740 - WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary 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.

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.

4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

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 Owner.

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 Owner.

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 Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner 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 Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner 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 Owner 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 Architect prior to the date certified for Substantial Completion. If the Architect'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 Architect.

1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect 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 Owner through the Architect 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 copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, 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 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.

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 (Not Applicable).

END OF SECTION 01740

SECTION 02051 – GENERAL SITE CONSTRUCTION REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Includes But Not Limited to
1. General procedures and requirements for Site Work.

PART 2 PRODUCTS

A. Manufacturers Recommendations
1. All products and materials used for site construction shall be installed according to manufacturer's recommendations, guidelines and instructions. Any discrepancy or deviation between manufacturer's recommendations and any plan or specification shall be brought to the attention of the site engineer at the time of bidding.

PART 3 EXECUTION

3.1 PREPARATION

A. Site Verification Of Conditions
1. 48 hours minimum prior to performing any work on site, contact Blue Stakes at (800) 662-4111 to arrange for utility location services.

3.2 PREPARATION

A. Protection
1. Spillage -
a. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways.
b. Remove spillage and sweep, wash, or otherwise clean project, streets, and highways.
2. Dust Control -
a. Take precautions necessary to prevent dust nuisance, both on-site and adjacent to public and private properties.
b. Correct or repair damage caused by dust.
3. Erosion Control -
a. Take precautions necessary to prevent erosion and transportation of soil downstream, to adjacent properties, and into on-site or off-site drainage systems.
b. Install, and maintain an erosion control plan as required by local and state law.
c. Repair and correct damage caused by erosion.
4. Protect site from fire caused by welding, cutting, smoking, or other sources of ignition.

B. If specified precautions are not taken or corrections and repairs made promptly, Owner may take such steps as may be deemed necessary and deduct costs of such from monies due to Contractor. Such action or lack of action on Owner's part does not relieve Contractor from responsibility for proper protection of the Work.

3.3 REPAIR / RESTORATION

A. Adjust existing covers, boxes, and vaults to grade.

B. Replace broken or damaged covers, boxes, and vaults.

C. Independently confirm size, location, and number of covers, boxes, and vaults which require adjustment.

3.4 FIELD QUALITY CONTROL

A. Notify Architect 48 hours prior to performing excavation or fill work.

B. If work has been interrupted by weather, scheduling, or other reason, notify Architect 24 hours minimum prior to intended resumption of grading or compacting.

C. Owner reserves right to require additional testing to re-affirm suitability of completed work including compacted soils which have been exposed to adverse weather conditions.

END OF SECTION 02051

SECTION 02076 – IMPERMEABLE MEMBRANES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes geomembrane liners for ponds and reservoirs.

B. See Division 31 Section "Earth Moving" for soil materials and geotextiles.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for geomembrane liners. Show panel layout, seams, penetrations, perimeter anchorage and methods of attachment and sealing to other construction. Differentiate between factory and field seams and joints.

C. Samples: For each geomembrane.

D. Product test reports.

E. Maintenance data.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: **An employer of workers trained and approved by manufacturer**.

B. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY

A. Special Warranty: Specified form in which geomembrane manufacturer, geomembrane liner manufacturer, and geomembrane liner Installer agree to repair or replace geomembrane liner that fail(s) in materials or workmanship or that deteriorate(s) under conditions of normal weather within specified warranty period. Warranty does not include deterioration or failure of geomembrane liner due to exposure to harmful chemicals, gases or vapors, abnormal and severe weather phenomena, fire, earthquakes, floods, vandalism, or abuse by persons, animals, or equipment.

1. Warranty Period: **20** year(s) from date of Substantial Completion.

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, manufacturers listed in other Part 2 articles.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in other Part 2 articles.

2.2 SHEET MATERIALS

A. General: Provide impervious geomembrane liner fabricated from sheet material indicated and complying with specified product characteristics.

B. EPDM Sheet: Formulated from EPDM, compounded for use in hydraulic structures and to permit heat-welded seams, and formed into uniform, flexible sheets.

1. Manufacturers:

a. Burke Environmental Products; Div. of Burke Industries.
b. Integra Plastics Inc.
c. Firestone

2. Reinforcing Scrim: One-ply polyester fabric totally encapsulated between two sheets.

a. Construction: 10 x 10 - 1000 d.

3. Nominal Thickness: 45-mil thick sheet per ASTM D 751.
4. Hydrostatic Resistance: Not less than 250-psi resistance per ASTM D 751, Method A, Procedure 1.
5. Breaking Strength: Not less than 220 lbf per ASTM D 751, Procedure A.
6. Tearing Resistance: Not less than 80 lbf per ASTM D 751, Procedure B.
7. Low-Temperature Flexibility: Pass, 1/8-inch mandrel, 4 hours at minus 40 deg F and per ASTM D 2136.
8. Ply Adhesion: Not less than 10 lbf/in. of seam width, or film tearing bond, according to ASTM D 413.

2.3 MISCELLANEOUS MATERIALS

A. Adhesives: Provide types of adhesive primers, compounds, solvents, and tapes recommended in writing by geomembrane liner manufacturer for bonding to structures (if required), for sealing of seams in geomembrane liner, and for sealing penetrations through geomembrane liner.

B. Penetration Assemblies: Provide manufacturer's standard factory-fabricated assemblies for sealing penetrations. Include joint sealant recommended in writing by geomembrane liner manufacturer and compatible with geomembrane liner, containment conditions, and materials.

C. Battens: Long-length strips of material indicated, size as shown on Drawings. Fabricate battens with sharp projections removed and edges eased and predrilled or punched for anchors. Provide anchors, or other type of attachment, of type and spacing recommended in writing by geomembrane liner manufacturer for attaching geomembrane liner system to substrate and as indicated.

2.4 FABRICATION

A. Fabricate geomembrane liner panels from sheets in sizes as large as possible with factory-sealed seams, consistent with limitations of weight and installation procedures. Minimize field seaming.

B. Fabricate flotation blocks, wrap in geomembrane, and attach to underside of floating cover according to manufacturer's written instructions.

C. Fabricate ballast tubes of sand-filled geomembrane and attach to top surface of floating cover according to manufacturer's written instructions.

D. Install built-in accessories, hatches, access panels, vents, and walkways on geomembrane floating cover.

2.5 SOURCE QUALITY CONTROL

A. General: Test for bonded seam strength and peel adhesion every 3000 feet or once per panel, whichever is more frequent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates, with Installer present, for compliance with requirements for soil compaction and grading; for subgrade free from angular rocks, rubble, roots, vegetation, debris, voids, protrusions, and ground water; and for other conditions affecting performance of geomembrane liner.

B. Preparation:

1. Provide temporary ballast, until edges are permanently secured, that does not damage geomembrane liner or substrate, to prevent uplift of geomembrane liner in areas with prevailing winds.
2. Prepare surfaces of construction penetrating through geomembrane liner according to geomembrane liner manufacturer's written instructions.

C. Place geomembrane liner over prepared surfaces to ensure minimum handling. Install according to Shop Drawings and to comply with geomembrane liner manufacturer's written instructions. In areas with prevailing winds, begin placing geomembrane liner at Project's upwind direction and proceed downwind. Install geomembrane liner in a relaxed condition, free from stress and with minimum wrinkles, and in full contact with subgrade. Do not bridge

over voids or low areas in the subgrade. Fit closely and seal around inlets, outlets, and other projections through geomembrane liner. Permanently secure edges.

D. Field Seams: Comply with geomembrane liner manufacturer's written instructions. Form seams by lapping edges of panels 2 to 4 inches unless instructions require a larger overlap. Wipe contact surfaces clean and free of dirt, dust, moisture, and other foreign materials. Use solvent-cleaning methods and grind geomembrane seam surfaces if recommended by geomembrane liner manufacturer. Proceed with seaming at required temperatures for materials and ambient conditions. Continuously bond sheet to sheet to construct single or double seams of width recommended for method of seaming used. Seal or fuse free seam edges as instructed. Inspect seams and reseal voids.

E. Installation in Anchor Trench: Install geomembrane linerin trench according to manufacturer's written instructions, backfill, and compact to lock liner into trench.

F. Attachment to Concrete: Use manufacturer's standard system to suit Project conditions. Support adhesive and geomembrane on not less than 8-inch wide concrete substrate, unless otherwise indicated.

G. Floating Cover Flotation Control: Connect drainage hoses in perimeter fold, sumps, or scuppers to pump or gravity drain system.

H. Liner Repairs: Repair tears, punctures, and other imperfections in geomembrane liner field and seams using patches of geomembrane liner material, liner-to-liner bonding materials, and bonding methods according to geomembrane liner manufacturer's written instructions. Apply bonding solvent or weld to contact surfaces of both patch and geomembrane liner, and press together immediately. Roll to remove wrinkles.

3.2 FIELD QUALITY CONTROL

A. Nondestructive Testing: Visually inspect seams and patches. Comply with ASTM D 4437 for Air Lance Test, Vacuum Box Testing, or Ultrasonic (High Frequency) Pulse Echo Testing or with GRI Test Method GM6, as applicable to geomembrane liner and seam construction. Record locations of failed seams and patches. For the record, individually number and date occurrences and details of leak and remedial action. Repair leaking seams and patches.

3.3 DISINFECTION

A. Disinfect the complete installation according to procedures in AWWA C652.

3.4 PROTECTION

A. Protect installed geomembrane liner according to manufacturer's written instructions. Repair or replace areas of geomembrane liner damaged by scuffing, punctures, traffic, rough subgrade, or other unacceptable conditions.

END OF SECTION 02076

SECTION 02110 – SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Extent of site clearing is shown on drawings.

B. Site clearing includes, but is not limited to:
1. Removal of trees and other vegetation.
2. Topsoil stripping.
3. Clearing and grubbing.

C. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division - 1 Specification sections, and the Geotechnical Information in Section 02200.

1.2 JOB CONDITIONS:

A. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction, Owner, and architect.

B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
1. Protect improvements on adjoining properties and on Owner's property.

C. Improvements on Adjoining Property: Authority for performing removal and alteration work on property adjoining Owner's property will be obtained by Owner prior to award of contract.
1. Extent of work on adjacent property is indicated on Drawings.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 SITE CLEARING:

A. Remove trees, shrubs, grass and other vegetation, improvements, debris or obstructions interfering with installation of new construction. Remove such items elsewhere on site or premises as specifically indicated. Removal includes digging out stumps and roots.

B. Topsoil: Topsoil is defined as silt and clay surface soil found in a depth of not less than 4". Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2" in diameter, and without weeds, roots, and other objectionable material.
1. Strip topsoil to whatever depths in which organic materials are encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.

2. Remove heavy growths of grass from areas before stripping.

3. Dispose of unsuitable or excess topsoil same as waste material, herein specified.

C. Clearing and Grubbing: Clear site of trees, shrubs and other vegetation, except for those indicated to be left standing.

1. Completely remove stumps, roots, and other debris protruding through ground surface.

2. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

3. Place fill material in horizontal layers not exceeding 6" loose depth, and thoroughly compact to a density equal to adjacent original ground.

3.2 DISPOSAL OF WASTE MATERIALS:

A. Burning is not permitted.

B. Remove and legally dispose waste materials and unsuitable and excess soil.

END OF SECTION 02110

SECTION 02200 - EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Sections includes earthwork.
1. Preparation of subgrade for building slabs, walks, docks, and pavements.
2. Vapor retarder, granular fill layer (drainage fill).
3. Backfilling of trenches within the contract limit lines, including but not limited to docks, planters, and walks adjacent to building.
4. Footings and foundation backfilll.

B. Related Sections: Excavation for Mechanical/Electrical Work: Refer to Divisions 15 and 16 sections for excavation and backfill required in conjunction with underground mechanical and electrical utilities, and buried mechanical and electrical appurtenances; not work of this section.

C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, and the Uniform Standard Specifications and applicable details for Public Works Construction from authority having jurisdiction, apply to work of this section.

D. Refer to the Geotechnical Report titled "Geotechnical Evaluation UDOT Maintenance Facility, 5600 West 5500 South, Hooper, Utah – dated _____, 2014, by Western Technologies, Inc., for additional grading requirements.

1.2 QUALITY ASSURANCE:

A. Codes and Standards: Perform excavation work in compliance with requirements of authorities having jurisdiction.

B. Testing and Inspection Service:
1. The owner shall engage a testing laboratory to perform soil testing, inspection and observation services for quality control testing during earthwork operations sufficient to enable Geotechnical engineer to prepare a written report that, in his opinion, the engineered fill has been constructed in accordance with the project specifications.
a. Coordinate scheduling of Geotechnical engineer with Owner's Representative to avoid delays in construction.

1.3 SUBMITTALS:

A. Test Reports: Submit following reports directly to Owner's Representative, Contractor and Architect from the testing agency, with copy to Contractor:
1. Test reports on borrow material.
2. Verification of each footing subgrade.
3. Field density test reports.
4. One optimum moisture-maximum density curve for each type of soil encountered.
5. Report of actual unconfined compressive strength and results of bearing tests of each strata tested for cohesive soils. Report results of shear angle test of remolded sample compacted to same density of onsite material for non-cohesive soils.

1.4 JOB CONDITIONS:

A. Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor.
   1. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

B. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.
   1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
   2. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Project Engineer and then only after acceptable temporary utility services have been provided.
   3. Provide minimum of 48-hour notice to Owner's Representative, and receive written notice to proceed before interrupting any utility.
   4. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

C. Use of Explosives:
   1. The use of explosives is not permitted.

D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
   1. Operate warning lights as recommended by authorities having jurisdiction.
   2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Definitions:
   1. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand to be placed under aggregate base course.
   2. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100% passing a 1" sieve and not more than 5% passing a No. 4 sieve.
   3. Backfill and Fill Materials: Satisfactory soil materials, native or imported materials, free of clay, rock or gravel larger than 2" in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter. Refer to soils report which takes precedence in material specifications in all instances.
      a. Structural fill: Well graded non-expansive granular material having a maximum size of 2" and not more than 15%, passing a #200 sieve, and a minimum dry density of at least 100 pounds per cubic foot (pcf).

b. Natural soils meeting the requirements for structural fill may be used as structural fill.
c. Pipe zone materials shall not be larger than 2” in any dimension for reinforced concrete pipe and ductile iron pipe. For PVC or other soft pipes the maximum dimension for pipe zone backfill shall be ¾”.
d. Drain rock: Gap graded non-expansive washed gravel having a maximum size of 1” with as little as practical quantity passing a #200 sieve, and a minimum dry density if at least 100 pounds per cubic foot (pcf).

4. Filter Fabric: Mirafi 140N or engineer approved equal.
5. Geofabric: Mirafi 600X or engineer approved equal

PART 3 - EXECUTION

3.1 EXCAVATION:

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be at Contractor's expense.
1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required too elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Engineer.

2. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Engineer.

C. Additional Excavation: When excavation has reached required subgrade elevations, notify Owner's Representative who will make an inspection of conditions.
1. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed.
2. Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes in work.

D. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
1. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

E. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
1. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.
2. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

F. Dewatering: Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

G. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
1. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
2. Dispose of excess soil material and waste materials as herein specified.
3. Sand shall be dry and protected as required.

H. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
1. Do not disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

I. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations grades as shown.

J. Excavation for Trenches: Dig trenches to the uniform width required for particular item to be installed. Provide 6" to 9" minimum clearance on both sides of pipe or conduit.
1. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.
2. Where rock is encountered, carry excavation 6" below required elevation and backfill with a 6" layer of crushed stone or gravel prior to installation of pipe.
3. For pipes or conduit 5" or less in nominal size and for flat- bottomed multiple-duct conduit units, do not excavate beyond indicated depths. Hand excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.
4. For pipes or conduit 6" or larger in nominal size, tanks and other mechanical/electrical work indicated to receive subbase, excavate to subbase depth or, if not otherwise indicated, to 6" below bottom of work to be supported.
5. Except as otherwise indicated, excavate for exterior water- bearing piping (water, steam, condensate, drainage) so top of piping is not less than 4’ below finished grade or to local standards whichever is deeper.
6. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.
7. Backfill trenches with concrete where trench excavations pass within 18" of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing.
   a. Refer to Section 03300 for concrete requirements.
8. Do not backfill trenches until tests and inspections have been made and backfilling authorized by Owner's Representative. Use care in backfilling to avoid damage or displacement of pipe systems.
9. For piping or conduit less than 18" below surface of roadways, provide 4" thick

concrete base slab support. After installation and testing of piping or conduit, provide minimum 4" thick encasement (sides and top) of concrete prior to backfilling or placement of roadway subbase.

K. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.2 COMPACTION:

A. Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.

B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum dry density for soils which exhibit a well-defined moisture density relationship (cohesive soils) determined in accordance with ASTM D 1557; and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils). In all cases the specific soils report for the project takes precedence.
1. Structures, Building Slabs and Steps, Pavements: Compact top 12" of subgrade and each layer of backfill or fill material at 95% maximum dry density for cohesive material or 95% relative dry density for cohesionless material. Scarify and moisture condition to within 3% of optimum moisture and recompact subgrade.
2. Lawn or Unpaved Areas: Compact top 6" of subgrade and each layer of backfill or fill material at 85% maximum dry density for cohesive materials and 90% relative dry density for cohesionless soils.
3. Walkways: Compact top 6" of subgrade and each layer of backfill or fill material at 90% maximum dry density for cohesive material or 95% relative dry density for cohesionless material.

C. Moisture Control: Uniformly apply water to soil material in manner to prevent free water appearing on surface during or subsequent to compaction operations.
1. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
2. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, ripping, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.3 BACKFILL AND FILL:

A. General: Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below.
1. In excavations, use satisfactory excavated or borrow material.
2. Under grassed areas, use satisfactory excavated or borrow material.
3. Under walks and pavements, use subbase material or satisfactory excavated or borrow material, or combination of both.
4. Under steps, use subbase material.
5. Under building slabs, use drainage fill material or free draining gravel, (less than 10% passing No. 4 sieve and less than 2% passing No. 200 sieve).
6. Under piping and conduit, use subbase material where subbase is indicated under piping or conduit, shape to fit bottom of pipe.

B. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Acceptance of construction below finish grade including, where applicable, damp

proofing, waterproofing, and perimeter insulation.

2. Inspection, testing, approval, and recording locations of underground utilities. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
4. Removal of trash and debris.
5. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
6. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
7. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

C. Placement and Compaction: Place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.

1. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.

D. Vapor retarder installation: Place vapor retarder sheeting in position with longest dimension parallel with direction of pour.

1. Lap joints 6 inches and seal with manufacturer's recommended mastic or pressure-sensitive tape.

3.4 GRADING:

A. Uniformly grade areas within contract limits under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.

C. Finish surfaces free from irregular surface changes, and as follows:

1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 1/2" above or below required subgrade elevations.
2. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 1/2" above or below required subgrade elevation.
3. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 1/2" above or below required subgrade elevation.

4. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2" when tested with a 10' straightedge.
5. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.5 PAVEMENT SUBBASE COURSE:

A. Subbase course consists of placing subbase material, in layers of specified thickness, over subgrade surface to support a pavement base course. Subbase thickness shall not be less than 6-inches. Recycled asphalt can be used crushed to match gradation requirements.

B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least a 12" width of shoulder simultaneously with compacting and rolling of each layer of subbase course.

D. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.
1. When a compacted subbase course is to be 6" thick or less, place material in a single layer. When more than 6" thick, place material in equal layers, except no single layer more than 6" or less than 3" in thickness when compacted.

3.6 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: All natural grades to be retained, all areas of cut and all areas of controlled fill or backfill shall be field tested by the testing laboratory for moisture content and density for compliance with specified values. Allow testing service to inspect subgrade and fill layers before further construction work is performed.
1. Perform optimum moisture-maximum density determinations for each different type of soil encountered in accordance with ASTM 1557.

2. Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2167 (rubber balloon method), ASTM D 2922 (nuclear method) or AASHTO T- 99, as applicable.

B. Testing: The number of tests performed shall be at the discretion of the testing laboratory except the number of field tests performed shall not be less than the minimum described below:
1. Within the building area, perform one test for every 1,000 square feet of fill per lift.
2. Paved Areas:
Minimum of one compaction test for every 10,000 square feet of fill (per lift), natural grade or cut.
3. Trenches: (Footings, etc.):
Minimum of 1 compaction test for each lift each 100 linear feet.
4. Perform test to verify minimum bearing capacity requirements at each column or spot footing.
5. Continuous Foundation:
Minimum of 1 compaction test per lift per each 100 linear feet

6. Curbs, Gutters and Ramps:
   Minimum of 1 test per lift per each 250 linear feet
7. Exterior Slabs:
   Minimum of 1 compaction test per each 2,000 square feet.

3.7 MAINTENANCE:

A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
   1. Repair and re-establish grades in settled, eroded, and rutted areas too specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.8 DISPOSAL OF EXCESS AND WASTE MATERIALS:

A. Removal to Designated Areas on Owner's Property: Transport acceptable excess excavated material to designated soil storage areas on Owner's property. Stockpile soil or spread as directed by Architect.

B. Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash and debris, and dispose of it off Owner's property.

END OF SECTION 02200

SECTION 02470 – GROUND ANCHORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. SECTION INCLUDES:

1. The Contractor shall furnish all labor, materials, tools, supervision, transportation, installation equipment, and incidentals necessary to complete the work specified herein and shown on the Contract Drawings. The work shall include but not be limited to mobilization, surveying, drilling, inserting, grouting, stressing, load testing, and lock-off of ground anchors at the appropriate locations.

2. Unless otherwise directed, the Contractor shall select the ground anchor type, drilling method, grouting method, grouting pressures, and, subject to the minimum values in the contract documents, determine the bond length, free-stressing (unbonded) length, and anchor diameter. The Contractor shall be responsible for installing ground anchors that will develop the load-carrying capacity indicated on the Contract Drawings in accordance with the testing subsection of this Specification.

3. The anchor tendon shall be protected from corrosion as shown on the Contract Drawings and in accordance with the requirements of this Specification.

B. RELATED SECTIONS:

1. Section 03300 – Cast In Place Concrete
2. Section 03054 – Oliphobic Sealer
2. Section 07901 - Caulking and Sealants

1.2 DEFINITIONS

A. Admixture: Substance added to the grout to either control bleed and/or shrinkage, improve flowability, reduce water content, or retard setting time.
B. Alignment Load (AL): A nominal minimum load applied to an anchor during testing to keep the testing equipment correctly positioned.
C. Anchor: A system, used to transfer tensile loads to the ground (soil or rock), which includes the prestressing steel, anchorage, corrosion protection, sheathings, spacers, centralizers, and grout.
D. Anchor Head: The means by which the prestressing force is permanently transmitted from the prestressing steel to the bearing plate. The anchor head includes wedges and a wedge plate for strand tendons or an anchor nut for bar tendons.
E. Anchor Nut: The threaded device that transfers the prestressing force in a bar to a bearing plate.
F. Anchorage: The combined system of anchor head, bearing plate, trumpet, and corrosion protection that is capable of transmitting the prestressing force from the prestressing steel to the surface of the ground or the supported structure.
G. Anchorage Cover: A cover to protect the anchorage from corrosion and physical damage.
H. Anchor Grout: See Primary Grout.
I. Apparent Free Tendon Length: The length of tendon which is apparently not bonded to the surrounding grout or ground, as calculated from the elastic load extension data during testing.
J. Bearing Plate: A steel plate under the anchor head that distributes the prestressing force to the anchored structure.
K. Bond Length: The length of the tendon that is bonded to the primary grout and capable of transmitting the applied tensile load to the surrounding soil or rock.

L. Bondbreaker: A sleeve placed over the anchor tendon in the free stressing length to ensure unobstructed elongation of the tendon during stressing.
M. Centralizer: A device to support and position the tendon in the drill hole so that a minimum grout cover is provided.
N. Coarse-Grained Soils: Soils with more than 50 percent, by weight, of the material larger than the No. 200 sieve size.
O. Cohesive Soils: Soils that exhibit plasticity. Atterberg limits are commonly used to determine plasticity and better define a soil as cohesive or non-cohesive.
P. Consolidation Grout: Portland cement grout that is injected into the hole prior to inserting the tendon to either reduce the permeability of the rock surrounding the hole or improve the ground conditions.
Q. Construction Quality Assurance (CQA) Inspector: The person/firm responsible for construction quality assurance (CQA) testing, monitoring, and other duties related to assuring the quality of construction and adherence to the Contract Drawings and Specifications.
R. Contract Drawings: The approved plans, profiles, typical cross sections, working drawings, and supplemental drawings which show the location, dimensions, and details of the work to be done.
S. Contractor: The person/firm responsible for performing the anchor work.
T. Corrosion Inhibiting Compound: Material used to protect against corrosion and/or lubricate the prestressing steel.
U. Coupler: The means by which the prestressing force can be transmitted from one partial-length of a prestressing tendon to another (mainly for bars).
V. Creep Movement: The movement that occurs during the creep test of an anchor under a constant load.
W. Creep Test: A test to determine the movement of the ground anchor at a constant load.
X. Design Load (DL): Anticipated final maximum effective load in the anchor after allowance for timedependent losses or gains. The design load includes appropriate load factors to ensure that the overall structure has adequate capacity for its intended use.
Y. Detensionable Anchor Head: An anchor head that is restressable and, in addition, permits the tendon to be completely detensioned in a controlled way at any time during the life of the structure.
Z. Downward Sloped Anchor: Any prestressed anchor that is placed at a slope greater than 5 degrees below the horizontal.
AA. Elastic Movement: The recoverable movement measured during an anchor test.
BB. Encapsulation: A corrugated or deformed tube protecting the prestressing steel against corrosion in the tendon bond length.
CC. Engineer: The engineer shall be appointed by the Owner to undertake the duties and powers assigned to the Engineer by the Contract Documents. The engineer is responsible for approving all design and specification changes and making design clarifications that may be required during construction.
DD. FPU: Specified minimum tensile strength of the tendon as defined in the pertinent ASTM Specification.
EE. Fine-Grained Soils: Soils with at least 50 percent, by weight, of the material smaller than the No. 200 sieve size.
FF. Free Stressing (Unbonded) Length: The designed length of the tendon that is not bonded to the surrounding ground or grout during stressing.
GG. Fully Bonded Anchor: Anchor in which the free stressing length without bondbreaker is grouted after stressing and so bonded to the surrounding structure or ground.
HH. Horizontal Anchor: Any prestressed anchor that is placed at a slope within (±5 degrees) of the horizontal.
II. Lift-Off: The load (lift-off load) in the tendon which can be checked at any specified time with the use of a hydraulic jack, by lifting the anchor head off the bearing plate.
JJ. Lock-Off Load: The prestressing force in an anchor immediately after transferring the load from the jack to the stressing anchorage.
KK. Non-Cohesive Soils: Material that is generally nonplastic.

LL. Permanent Anchor: Any prestressed ground anchor that is intended to remain and function as part of a permanent structure. A permanent anchor has to fulfill its function for an extended period of time and thus requires special design, corrosion protection, and supervision during installation.

MM. Performance Test: Incremental cyclic test loading of a prestressed anchor in which the total movement of the anchor is recorded at each increment.

NN. Primary Grout: Portland cement grout that is injected into the anchor hole prior to or after the installation of the anchor tendon to provide for the force transfer to the surrounding ground along the bond length of the tendon. Primary grout is also known as anchor grout.

OO. Proof Test: Incremental loading of a prestressed anchor recording the total movement of the anchor at each increment.

PP. Pulling Head: Temporary anchoring device behind the hydraulic jack during stressing.

QQ. Relaxation: The decrease of stress or load with time while the tendon is held under constant strain.

RR. Residual Movement: The non-elastic (i.e., non-recoverable) movement of an anchor measured during load testing.

SS. Restressable Anchor Head: An anchor head that permits the anchor load, throughout the life of the structure, to be measured by lift-off checking and adjusted by shimming/unshimming or threadturning.

TT. Safety Factor: The ratio of the ultimate capacity to the working load used for the design of any component or interface.

UU. Sheath: A smooth or corrugated pipe or tube protecting the prestressing steel in the free stressing length against corrosion.

VV. Shop Drawings: All drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data which are prepared for or by the Contractor or any subcontractor, manufacturer, supplier, or distributor and which illustrate the equipment, material, or any other matter relating to the work.

WW. Spacer: A device to separate elements of a multiple-element tendon to ensure full bond development of each prestressing steel element.

XX. Stressing Anchorage: See Anchorage.

YY. Subcontractor: The Subcontractor is a person/firm who has a direct or indirect contract relationship with the Contractor to perform any of the work.

ZZ. Supplier: Any person/firm who supplies materials or equipment for the work, including that fabricated to a special design, and may also be a Subcontractor.

AAA. Support of Excavation Anchor: A prestressed ground anchor which functions temporarily, generally 18 to 36 months in duration, and which is not considered by the owner to fulfill a critical function.

BBB. Temporary Critical Anchor: Any prestressed ground anchor for a temporary use that is judged by the owner to provide a critical function. Temporary critical anchors are commonly designed using the same criteria as permanent anchors. Temporary critical anchors installed in corrosive environments may require corrosion protection.

CCC. Tendon: The complete anchor assembly (excluding grout) consisting of prestressing steel, corrosion protection, sheathings, and coating when required, as well as spacers and centralizers.

DDD. Test Load (TL): The maximum load to which the anchor is subjected during testing.

EEE. Trumpet: Device to provide corrosion protection in the transition length from the anchorage to the free stressing length.

FFF. Unbonded Anchor: Anchor in which the free stressing length remains permanently unbonded.

GGG. Upward Sloped Anchor: Any prestressed anchor that is placed at a slope greater than 5 degrees above the horizontal.

HHH. Wedge: The device that transfers the prestressing force in the strand to the wedge plate.

III. Wedge Plate: The device that holds the wedges of multistrand tendons and transfers the anchor force to the bearing plate.

JJJ. Working Load: Equivalent term for Design Load.

1.3 REFERENCES

A. Contract Drawings

B. Ground Anchor Inspector's Manual, from "In-Situ Soil Improvement Techniques", American Association of State Highway and Transportation Officials - Associated Contractors of America - American Road and Transportation Builders Association (AASHTO-AGCARTBA), Task Force 27 Report, 1990.

C. Latest version of Federal Highway Administration publication FHWA-IF-99-015, "Geotechnical Engineering Circular No.4: Ground Anchors and Anchored Systems"

D. Latest version of American Society for Testing and Materials (ASTM) standards:
1. ASTM A 53 Standard Specification for Steel Pipe
2. ASTM A 500 Standard Specification for Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
3. ASTM A 536 Standard Specification for Ductile Iron Castings
4. ASTM A 775 Standard Specification for Epoxy-Coated Reinforcing Steel Bars
5. ASTM A 779 Standard Specification for Steel Strand, Seven Wire, Uncoated, Compacted, Stress-relieved for Prestressed Concrete
6. ASTM A 882 Standard Specification for Epoxy-Coated Seven-Wire Prestressing Steel Strand
7. ASTM A 981 Standard Test Method for Evaluating Bond Strength for 15.2 mm (0.6 in.) Diameter Prestressing Steel Strand, Grade 270, Uncoated, used in Prestressed Ground Anchors
8. ASTM C 109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm Cube Specimens)
9. ASTM C 143 Standard Test Method for Slump of Hydraulic Cement Concrete
10. ASTM D 1248 Standard Specification for Polyethylene Plastic Molding and Extrusion Materials
11. ASTM D 1784 Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds
12. ASTM D 1785 Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedule 40, 80 and 120
13. ASTM D 2241 Standard Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
14. ASTM D 4101 Standard Specification for Propylene Plastic Injection and Extrusion Materials
15. ASTM G 57 Standard Method for Field Measurements of Soil Resistivity under the Wenner Four Electrode Method

E. Latest version of American Association of State Highway and Transportation Officials (AASHTO) standards:
1. AASHTO M 85 Portland Cement
2. AASHTO M 183 Structural Steel
3. AASHTO M 203 Uncoated Seven-wire Stress-relieved Steel Strand
4. AASHTO M 222 High-strength Low-alloy Structural Steel with 50,000 psi Minimum Yield Point to 4 Inches Thick
5. AASHTO M 252 Corrugated Polyethylene Drainage Tubing
6. AASHTO M 275 Uncoated High-strength Steel Bar
7. AASHTO M 284 Epoxy-coated Reinforcing Bars
8. AASHTO T 288 Determining Minimum Laboratory Soil Resistivity
9. AASHTO T 289 Determining pH of Soil for Use in Corrosion Testing
10. AASHTO T 290 Determining Water Soluble Sulfate Ion Content in Soil

F. American Water Works Association (AWWA) C 105, "Notes on Procedures for Soil

Survey Tests and Observations and Their Interpretation to Determine Whether Polyethylene Encasement Should Be Used," Appendix A

G. Latest version of Post Tensioning Institute (PTI) standards:
1. PTI, "Post Tensioning Manual"
2. PTI, "Specification for Unbonded Single Strand Tendons"
3. PTI, "Recommendations for Prestressed Rock and Soil Anchors"

1.4 QUALITY ASSURANCE:

A. The Contractor performing the work described in this Specification shall have installed permanent ground anchors for a minimum of three (3) years.

B. The Contractor shall assign an engineer to supervise the work with at least three (3) years of experience in the design and construction of permanent anchored structures. The Contractor may not use consultants or manufacturer's representatives in order to meet the requirements of this section. Drill operators and on-site supervisors shall have a minimum of one (1) year experience installing permanent ground anchors with the Contractor's organization.

C. The Construction Quality Assurance (CQA) Inspector will monitor all aspects of anchored wall construction. The CQA Inspector will perform material conformance testing as required. The Contractor shall be aware of the activities required by the CQA Inspector and shall account for these activities in the construction schedule. The Contractor shall correct all deficiencies and nonconformities identified by the CQA Inspector at no additional cost to the Owner.

1.5 EXISTING CONDITIONS

A. Prior to beginning work, the Owner shall provide utility location plans to the Contractor. The Contractor is responsible for contacting a utility location service to verify the location of underground utilities before starting the work.

B. The Contractor shall survey the condition of adjoining properties and make records and photographs of any evidence of settlement or cracking of any adjacent structures. The Contractor's report of this survey shall be delivered to the Owner before work begins.

1.6 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. The Contractor shall submit a list containing at least five (5) projects completed within the last five (5) years. For each project, the Contractor shall include with this submittal, at a minimum: (1) name of client contact, address, and telephone number; (2) location of project; (3) contract value; and (4) scheduled completion date and actual completion date for the project.

C. Resumes of the Contractor's staff shall be submitted to the Owner for review as part of the Contractor bid. Only those individuals designated as meeting the qualification requirements shall be used for the project. The Contractor cannot substitute for any of these individuals without written approval of the Owner or Owner's Engineer (Engineer). The Engineer shall approve or reject the Contractor's qualifications and staff within fifteen (15) working days after receipt of the submission. Work shall not be started on any anchored wall system nor materials ordered until the Contractor's qualifications have been approved by the Engineer. The Engineer may suspend the work if the Contractor

substitutes unqualified personnel for approved personnel during construction. If work is suspended due to the substitution of unqualified personnel, the Contractor shall be fully liable for additional costs resulting from the suspension of work and no adjustment in contract time resulting from the suspension of work will be allowed.

D. The Contractor shall prepare and submit to the Engineer for review and approval Working Drawings and a design submission describing the ground anchor system or systems intended for use. The Working Drawings and design submission shall be submitted thirty (30) working days prior to the commencement of the ground anchor work. The Working Drawings and design submission shall include the following:

1. A ground anchor schedule giving:
    a. Ground anchor number;
    b. Ground anchor design load;
    c. Type and size of tendon;
    d. Minimum total anchor length;
    e. Minimum bond length;
    f. Minimum tendon bond length; and
    g. Minimum unbonded length.

2. A drawing of the ground anchor tendon and the corrosion protection system including details for the following:
    a. Spacers and their location;
    b. Centralizers and their location;
    c. Unbonded length corrosion protection system;
    d. Bond length corrosion protection system;
    e. Anchorage and trumpet; and
    f. Anchorage corrosion protection system.

3. Certificates of Compliance for the following materials, if used. The certificate shall state that the material or assemblies to be provided will fully comply with the requirements of the contract.
    a. Prestressing steel, strand or bar;
    b. Portland cement;
    c. Prestressing hardware;
    d. Bearing plates; and
    e. Corrosion protection system.

E. The Engineer shall approve or reject the Contractor's Working Drawings and design submission within thirty (30) working days after receipt of the submission. Approval of the design submittal does not relieve the Contractor of his responsibility for the successful completion of the work.

F. The Contractor shall submit to the Engineer for review and approval or rejection mill test reports for the prestressing steel and the bearing plate steel. The Engineer may require the Contractor to provide samples of any ground anchor material intended for use on the project. The Engineer shall approve or reject the prestressing steel and bearing plate steel within five (5) working days after receipt of the test reports. The prestressing steel and bearing plates shall not be incorporated in the work without the Engineer's approval.

G. The Contractor shall submit to the Engineer for review and approval or rejection calibration data for each test jack, load cell, primary pressure gauge and reference pressure gauge to be used. The Engineer shall approve or reject the calibration data within five (5) working days after receipt of the data. Testing cannot commence until the Engineer has approved the jack, load cell, primary pressure gauge and reference pressure gauge calibrations.

H. The Contractor shall submit to the Engineer within twenty (20) calendar days after completion of the ground anchor work a report containing:
1. Prestressing steel manufacturer's mill test reports for the tendons incorporated in the installation;
2. Grouting records indicating the cement type, quantity injected and the grout pressures;
3. Ground anchor test results and graphs; and
4. As-built drawings showing the location and orientation of each ground anchor, anchor capacity, tendon type, total anchor length, bond length, unbonded length, and tendon bond length as installed and locations of all instruments installed by the Owner.

PART 2- MATERIALS

2.1 GENERAL

A. The Contractor shall not deliver materials to the site until the Engineer has approved the submittals outlined in Part 1.04 of this Specification.

B. The designated storage location or locations shall be protected by the Contractor from theft, vandalism, passage of vehicles, and other potential sources of damage to materials delivered to the site.

C. The Contractor shall protect the materials from the elements by appropriate means. Prestressing steel strands and bars shall be stored and handled in accordance with the manufacturer’s recommendations and in such a manner that no damage to the component parts occurs. All steel components shall be protected from the elements at all times. Cement and additives for grout shall be stored under cover and protected against moisture.

2.2 ADMIXTURES

A. Admixtures which control bleed, improve flowability, reduce water content, and retard set may be used in the grout subject to the approval of the Engineer. Admixtures, if used, shall be compatible with the prestressing steels and mixed in accordance with the manufacturer's recommendations. Expansive admixtures may only be added to the grout used for filling sealed encapsulations, trumpets, and anchorage covers. Accelerators shall not be permitted.

2.3 ANCHORAGE DEVICES

A. Stressing anchorages shall be a combination of either a steel bearing plate with wedge plate and wedges, or a steel bearing plate with a threaded anchor nut. The steel bearing and wedge plate may also be combined into a single element. Anchorage devices shall be capable of developing 95 percent of the specified minimum ultimate tensile strength (SMTS) of the prestressing steel tendon. The anchorage devices shall conform to the static strength requirements of Section 3.1.6 (1) and Section 3.1.8 (1) and (2) of the PTI "Guide Specification for Post-Tensioning Materials."

B. The bearing plate shall be fabricated from steel conforming to AASHTO M 183 or M 222 specifications, or equivalent, or may be a ductile iron casting conforming to ASTM A 536.

C. The trumpet shall be fabricated from a steel pipe or tube or from PVC pipe. Steel pipe or tube shall conform to the requirements of ASTM A 53 for pipe or ASTM A 500 for tubing. Steel trumpets shall have a minimum wall thickness of 1/8 inch for diameters up to 4 inch and ¼ inch for larger diameters. PVC pipe shall conform to ASTM A 1785, Schedule 40 minimum. PVC trumpets shall be positively sealed against the bearing plate and aligned

with the tendon to prevent cracking during stressing.

D. Anchorage covers shall be fabricated from steel or plastic with a minimum thickness of 3/32 inch. The joint between the cover and the bearing plate shall be watertight.

E. Wedges shall be designed to preclude premature failure of the prestressing steel due to notch or pinching effects under static and dynamic strength requirements of Section 3.1.6 (1) and Section 3.1.8 (1) and 3.1.8 (2) of the PTI "Post Tensioning Manual." Wedges shall not be reused.

F. Wedges for epoxy coated strand shall be designed to be capable of biting through the epoxy coating and into the strand. Removal of the epoxy coating from the strand to allow the use of standard wedges shall not be permitted. Anchor nuts and other threadable hardware for epoxy coated bars shall be designed to thread over the epoxy coated bar and still comply with the requirements for carrying capacity.

2.4 BONDBREAKER

A. The bondbreaker shall be fabricated from a smooth plastic tube or pipe having the following properties: (1) resistant to chemical attack from aggressive environments, grout, or corrosion inhibiting compound; (2) resistant to aging by ultra-violet light; (3) fabricated from material nondetrimental to the tendon; (4) capable of withstanding abrasion, impact, and bending during handling and installation; (5) enable the tendon to elongate during testing and stressing; and (6) allow the tendon to remain unbonded after lock-off.

2.5 CEMENT GROUT

A. Type I, II, III, or V Portland cement conforming to AASHTO M 85 shall be used for grout. The grout shall be a pumpable neat mixture of cement and water and shall be stable (bleed less than 2 percent), fluid, and provide a minimum 28-day compressive strength of at least 3000 psi measured in accordance with ASTM C 109 at time of stressing.

2.6 CENTRALIZERS

A. Centralizers shall be fabricated from plastic, steel or material which is nondetrimental to the prestressing steel. Wood shall not be used. The centralizer shall be able to support the tendon in the drill hole and position the tendon so a minimum of ½ inch of grout cover is provided and shall permit grout to freely flow around the tendon and up the drill hole.

B. Centralizers are not required on pressure injected anchors installed in coarse grained soils when the grouting pressure exceeds 145 psi, nor on hollow stem-augered anchors when they are grouted through the auger with grout having a slump of 9 inch or less.

2.7 CORROSION INHIBITING COMPOUND

A. The corrosion inhibiting compound placed in either the free length or the trumpet area shall be an organic compound (i.e., grease or wax) with appropriate polar moisture displacing, corrosion inhibiting additives and self-healing properties. The compound shall permanently stay viscous and be chemically stable and nonreactive with the prestressing steel, the sheathing material, and the anchor grout.

2.8 GROUT TUBES

A. Grout tubes shall have an adequate inside diameter to enable the grout to be pumped to the bottom of the drill hole. Grout tubes shall be strong enough to withstand a minimum grouting pressure of 145 psi. Postgrout tubes shall be strong enough to withstand postgrouting pressures.

2.9 HEAT SHRINKABLE SLEEVES

A. Heat shrinkable sleeves shall be fabricated from a radiation crosslinked polyolefin tube internally coated with an adhesive sealant. Prior to shrinking, the tube shall have a nominal wall thickness of 0.024 inch. The adhesive sealant inside the heat shrinkable tube shall have a nominal thickness of 0.02 inch.

2.10 PRESTRESSING STEEL

A. Ground anchor tendons shall be fabricated from single or multiple elements of one of the following prestressing steels:
1. Steel bars conforming to AASHTO M 275
2. Seven-wire, low-relaxation strands conforming to AASHTO M 203
3. "Compact" seven-wire, low-relaxation strands conforming to ASTM A 779
4. Epoxy coated strand conforming to ASTM A 882.
5. Epoxy coated reinforcing steel bars conforming to ASTM A 775.

B. Centralizers shall be provided at maximum intervals of 10 feet with the deepest centralizer located 12 inches from the end of the anchor and the upper centralizer for the bond zone located no more than 5 feet from the top of the tendon bond length. Spacers shall be used to separate the steel strands of strand tendons. Spacers shall be provided at maximum intervals of 10 feet and may be combined with centralizers.

2.11 PRESTRESSING STEEL COUPLERS

A. Prestressing steel bar couplers shall be capable of developing 100 percent of the minimum specified ultimate tensile strength of the prestressing steel bar. Steel strands used for a soil or rock anchor shall be continuous with no splices, unless approved by the Engineer.

2.12 SHEATH

A. A sheath shall be used as part of the corrosion protection system for the unbonded length portion of the tendon. The sheath shall be fabricated from one of the following:
1. A polyethylene tube pulled or pushed over the prestressing steel. The polyethylene shall be Type II, III or IV as defined by ASTM D 1248 (or approved equal). The tubing shall have a minimum wall thickness of 1/16 inch.
2. A hot-melt extruded polypropylene tube. The polypropylene shall be cell classification B55542-11 as defined by ASTM D 4101 (or approved equal). The tubing shall have a minimum wall thickness of 1/16 inch.
3. A hot-melt extruded polyethylene tube. The polyethylene shall be high density Type III as defined by ASTM D1248 (or approved equal). The tubing shall have a minimum wall thickness of 1/16 inch.
4. Steel tubing conforming to ASTM A 500. The tubing shall have a minimum wall thickness of ¼ inch.
5. Steel pipe conforming to ASTM A 53. The pipe shall have a minimum wall thickness of ¼ inch.
6. Plastic pipe or tube of PVC conforming to ASTM D 1784 Class 13464-B. The pipe or tube shall be Schedule 40 at a minimum.
7. A corrugated tube conforming to the requirement of the tendon bond length encapsulation (Part 2.14).

2.13 SPACERS

A. Spacers shall be used to separate elements of a multi-element tendon and shall permit grout to freely flow around the tendon and up the drill hole. Spacers shall be fabricated from plastic, steel or material which is nondetrimental to the prestressing steel. Wood

shall not be used. A combination centralizer-spacer may be used.

2.14 TENDON BOND LENGTH ENCAPSULATIONS

A. When the Contract Drawings require the tendon bond length to be encapsulated to provide additional corrosion protection, the encapsulation shall be fabricated from one of the following:
1. High density corrugated polyethylene tubing conforming to the requirements of AASHTO M 252 and having a minimum wall thickness of 1/16 inch except pregrouted tendons which may have a minimum wall thickness of 0.04 inch.
2. Deformed steel tubing or pipes conforming to ASTM A 52 or A 500 with a minimum wall thickness of ¼ inch.
3. Corrugated, polyvinyl chloride tubes manufactured from rigid PVC compounds conforming to ASTM D 1784, Class 13464-B.
4. Fusion-bonded epoxy conforming to the requirements of AASHTO M 284.

2.15 WATER

A. Water for mixing grout shall be potable, clean, and free of injurious quantities of substances known to be harmful to Portland cement or prestressing steel.

PART 3 DESIGN CRITERIA

A. Unless otherwise directed, the Contractor shall select the type of tendon to be used. The tendon shall be sized so the design load does not exceed 60 percent of the specified minimum tensile strength (SMTS) of the prestressing steel. The lock-off load for the tendon shall be chosen based on anticipated time or activity dependent load changes, but shall not exceed 70 percent of the SMTS of the prestressing steel. The prestressing steel shall be sized so the maximum test load does not exceed 80 percent of the SMTS of the prestressing steel.

B. The Contractor shall be responsible for determining the bond length necessary to develop the design load indicated on the Contract Drawings or the approved Working Drawings in accordance with Part 6 of this Specification. The minimum bond length shall be 15 feet for strand tendons in rock and 10 feet for bar tendons in rock. The minimum bond length shall be 15 feet for strand and bar tendons in soil. The minimum tendon bond length shall be 10 feet.

C. The free stressing length (unbonded length) for rock and soil anchors shall not be less than 10 feet for bar tendons and 15 feet for strand tendons. The free stressing length (unbonded length) shall extend at least 5 feet or 20 percent of the height of the wall, whichever is greater, behind the critical failure surface. The critical failure surface shall be evaluated using slope stability or similar procedures.

PART 4 CORROSION PROTECTION

4.1 PROTECTION REQUIREMENTS

A. The corrosion protection systems shall be designed and constructed to provide reliable ground anchors for temporary and permanent structures. Contractor shall select a Class I or a Class II as required to achieve a 100 year protective life.

4.12 ANCHORAGE PROTECTION

A. All stressing anchorages permanently exposed to the atmosphere shall be grout-filled cover, except, for restressable anchorages, a corrosion inhibiting compound must be

used. Stressing anchorages encased in concrete at least 2 inch thick do not require a cover.

B. The trumpet shall be sealed to the bearing plate and shall overlap the unbonded length corrosion protection by at least 4 inch. The trumpet shall be long enough to accommodate movements of the structure and the tendon during testing and stressing. On strand tendons, the trumpet shall be long enough to enable the tendon to make a transition from the diameter of the tendon along the unbonded length to the diameter of the tendon at the wedge plate without damaging the encapsulation.

C. The trumpet shall be completely filled with grout, except restressable anchorages must use corrosion inhibiting compounds. Compounds may be placed any time during construction. Compound-filled trumpets shall have a permanent seal between the trumpet and the unbonded length corrosion protection. Grout must be placed after the ground anchor has been tested and stressed to the lock-off load. Trumpets filled with grout shall have either a temporary seal between the trumpet and the unbonded length corrosion protection or the trumpet shall fit tightly over the unbonded length corrosion protection for a minimum of 4 inch.

4.3 UNBONDED LENGTH PROTECTION

A. Corrosion protection of the unbonded length shall be provided by a combination of sheaths, sheath filled with a corrosion inhibiting compound or grout, or a heat shrinkable tube internally coated with a mastic compound, depending on the tendon class. The corrosion inhibiting compound shall completely coat the tendon elements, fill the void between them and the sheath, and fill the interstices between the wires of 7-wire strands. Provisions shall be made to retain the compound within the sheath.

B. The corrosion protective sheath surrounding the unbonded length of the tendon shall be long enough to extend into the trumpet, but shall not come into contact with the stressing anchorage during testing. Any excessive protection length shall be trimmed off.

C. For pregrouted encapsulations and all Class I tendons, a separate bondbreaker or common sheath shall be provided for supplemental corrosion protection or to prevent the tendon from bonding to the grout surrounding the unbonded length.

4.4 UNBONDED LENGTH/BOND LENGTH TRANSITION

A. The transition between the corrosion protection for the bonded and unbonded lengths shall be designed and fabricated to ensure continuous protection from corrosive attack.

4.5 TENDON BOND LENGTH PROTECTION FOR GROUT PROTECTED TENDONS (Class II)

A. Cement grout can be used to protect the tendon bond length in non-aggressive ground when the installation methods ensure that the grout will remain fully around the tendon. The grout shall overlap the sheathing of the unbonded length by at least 1 inch.

B. Centralizers or grouting techniques shall ensure a minimum of ½ inch of grout cover over the tendon bond length.

4.16 TENDON BOND LENGTH PROTECTION FOR ENCAPSULATED TENDONS (Class I)

A. A grout-filled, corrugated plastic encapsulation or a grout-filled, deformed steel tube shall

be used. The prestressing steel can be grouted inside the encapsulation prior to inserting the tendon into the drill hole or after the tendon has been placed.

B. Centralizers or grouting techniques shall ensure a minimum of ½ inch of grout cover over the encapsulation.

4.7 EPOXY (Class I)

A. Fusion-bonded epoxy may be used to provide a layer of protection for the steel tendon in addition to the cement grout.

4.8 COUPLER PROTECTION

A. On encapsulated bar tendons (Class I), the coupler and any adjacent exposed bar sections shall be covered with a corrosion-proof compound or wax-impregnated cloth tape. The coupler area shall be covered by a smooth plastic tube complying with the requirements set forth in Part 2.12 of this Specification, overlapping the adjacent sheathed tendon by at least 1 inch. The two joints shall be sealed each by a coated heat shrink sleeve of at least 6 inch length, or approved equal. The corrosion-proof compound shall completely fill the space inside the cover tube.

B. Corrosion protection details for strand couplers, if specifically permitted by the contract documents, shall be submitted for approval of the Engineer.

PART 5 CONSTRUCTION

5.1 TENDON STORAGE AND HANDLING

A. Tendons shall be handled and stored in such a manner as to avoid damage or corrosion. Damage to the prestressing steel, the corrosion protection, and/or the epoxy coating as a result of abrasions, cuts, nicks, welds and weld splatter will be cause for rejection by the Engineer. The prestressing steel shall be protected if welding is to be performed in the vicinity. Grounding of welding leads to the prestressing steel is forbidden. Prestressing steel shall be protected from dirt, rust, or deleterious substances. A light coating of rust on the steel is acceptable. If heavy corrosion or pitting is noted, the Engineer shall reject the affected tendons.

B. The Contractor shall use care in handling and storing the tendons at the site. Prior to inserting a tendon in the drill hole, the Contractor and the CQA Inspector shall examine the tendon for damage to the encapsulation and the sheathing. If, in the opinion of the CQA Inspector, the encapsulation is damaged, the Contractor shall repair the encapsulation in accordance with the tendon supplier's recommendations. If, in the opinion of the CQA Inspector, the smooth sheathing has been damaged, the Contractor shall repair it with ultra high molecular weight polyethylene tape. The tape should be spiral wound around the tendon to completely seal the damaged area. The pitch of the spiral shall ensure a double thickness at all points.

C. Banding for fabricated tendons shall be padded to avoid damage to the tendon corrosion protection. Upon delivery, the fabricated anchors or the prestressing steel for fabrication of the tendons on site and all hardware shall be stored and handled in such a manner to avoid mechanical damage, corrosion, and contamination with dirt or deleterious substances.

D. Lifting of the pre-grouted tendons shall not cause excessive bending, which can debond the prestressing steel from the surrounding grout.

E. Prestressing steel shall not be exposed to excessive heat (i.e., more than 450°F).

5.2 ANCHOR FABRICATION

A. Anchors shall be either shop or field fabricated from materials conforming to Part 2 of the Specification and as shown in the approved Working Drawings and schedules.

B. Prestressing steel shall be cut with an abrasive saw or, with the approval of the prestressing steel supplier, an oxyacetylene torch.

C. All of the tendon bond length, especially for strand, must be free of dirt, manufacturers' lubricants, corrosion-inhibitive coatings, or other deleterious substances that may significantly affect the grout-to-tendon bond or the service life of the tendon.

D. Pregrouting of encapsulated tendons shall be done on an inclined, rigid frame or bed by injecting the grout from the low end of the tendon.

5.3 DRILLING

A. Drilling methods shall be left to the discretion of the Contractor, whenever possible. The Contractor shall be responsible for using a drilling method to establish a stable hole of adequate dimensions, within the tolerances specified. Drilling methods may involve, amongst others, rotary, percussion, rotary/percussive or auger drilling; or percussive or vibratory driven casing.

B. Holes for anchors shall be drilled at the locations and to the length, inclination and diameter shown on the Contract Drawings or the approved Working Drawings. The drill bit or casing crown shall not be more than 1/8 inch smaller than the specified hole diameter. At the ground surface the drill hole shall be located within 12 inches of the location shown on the Contract Drawings or the approved Working Drawings. The drill hole shall be located so the longitudinal axis of the drill hole and the longitudinal axis of the tendon are parallel. In particular, the ground anchor hole shall not be drilled in a location that requires the tendon to be bent in order to enable the bearing plate to be connected to the supported structure. At the point of entry the ground anchor shall be installed within plus/minus three (3) degrees of the inclination from horizontal shown on the Contract Drawings or the approved Working Drawings. At the point of entry the horizontal angle made by the ground anchor and the structure shall be within plus/minus three (3) degrees of a line drawn perpendicular to the plane of the structure unless otherwise shown on the Contract Drawings or approved Working Drawings. The ground anchors shall not extend beyond the right-of-way or easement limits shown on the Contract Drawings.

5.4 TENDON INSERTION

A. Tendons shall be placed in accordance with the Contract Drawings and details and the recommendations of the tendon manufacturer or specialist anchor contractor. The tendon shall be inserted into the drill hole to the desired depth without difficulty. When the tendon cannot be completely inserted, the Contractor shall remove the tendon from the drill hole and clean or redrill the hole to permit insertion. Partially inserted tendons shall not be driven or forced into the hole.

B. Each anchor tendon shall be inspected by field personnel during installation into the drill hole or casing. Damage to the corrosion protection system shall be repaired, or the tendon replaced if not repairable. Loose spacers or centralizers shall be reconnected to prevent shifting during insertion. Damaged fusion-bonded epoxy coatings shall be repaired in accordance with the manufacturer's recommendations. If the patch is not

allowed to cure prior to inserting the tendon in the drill hole, the patched area shall be protected by tape or other suitable means.

C. The rate of placement of the tendon into the hole shall be controlled such that the sheathing, coating, and grout tubes are not damaged during installation of the tendon. Anchor tendons shall not be subjected to sharp bends. The bottom end of the tendon may be fitted with a cap or bullnose to aid its insertion into the hole, casing, or sheathing.

5.5 GROUTING

A. The Contractor shall use a neat cement grout or a sand-cement grout. The cement shall not contain lumps or other indications of hydration. Admixtures, if used, shall be mixed in accordance with the manufacturer's recommendations.

B. The grouting equipment shall produce a grout free of lumps and undispersed cement. A positive displacement grout pump shall be used. The pump shall be equipped with a pressure gauge to monitor grout pressures. The pressure gauge shall be capable of measuring pressures of at least 145 psi or twice the actual grout pressures used by the Contractor, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The mixer should be capable of continuously agitating the grout.

C. The grout shall be injected from the lowest point of the drill hole. The grout may be pumped through grout tubes, casing, hollow-stem-augers, or drill rods. The grout can be placed before or after insertion of the tendon. The quantity of the grout and the grout pressures shall be recorded. The grout pressures and grout takes shall be controlled to prevent excessive heave or fracturing.

D. After the tendon is installed, the drill hole may be filled in one continuous grouting operation except that pressure grouting shall not be used in the free length zone. The grout at the top of the drill hole shall not contact the back of the structure or the bottom of the trumpet.

E. If the ground anchor is installed in a fine-grained soil using drill holes larger than 6 inches in diameter, then the grout above the top of the bond length shall be placed after the ground anchor has been tested and stressed. The Engineer will allow the Contractor to grout the entire drill hole at the same time if the Contractor can demonstrate that his particular ground anchor system does not derive a significant portion of its load-carrying capacity from the soil above the bond length portion of the ground anchor.

F. If grout protected tendons are used for ground anchors anchored in rock, then pressure grouting techniques shall be utilized. Pressure grouting requires that the drill hole be sealed and that the grout be injected until a minimum 50 psi grout pressure (measured at the top of the drill hole) can be maintained on the grout for at least five (5) minutes.

G. The grout tube may remain in the hole on completion of grouting if the tube is filled with grout.

H. After grouting, the tendon shall not be loaded for a minimum of three (3) days.

5.6 ANCHORAGE INSTALLATION

A. The anchor bearing plate and the anchor head or nut shall be installed perpendicular to the tendon, within plus/minus three (3) degrees and centered on the bearing plate, without bending or kinking of the prestressing steel elements. Wedge holes and wedges

shall be free of rust, grout, and dirt.

B. The stressing tail shall be cleaned and protected from damage until final testing and lock-off. After the anchor has been accepted by the Engineer, the stress tail shall be cut to its final length according to the tendon manufacturer's recommendations.

C. The corrosion protection surrounding the unbonded length of the tendon shall extend up beyond the bottom seal of the trumpet or 4 inches into the trumpet if no trumpet seal is provided. If the protection does not extend beyond the seal or sufficiently far enough into the trumpet, the Contractor shall extend the corrosion protection or lengthen the trumpet.

D. The corrosion protection surrounding the unbonded length of the tendon shall not contact the bearing plate or the anchor head during testing and stressing. If the protection is too long, the Contractor shall trim the corrosion protection to prevent contact.

PART 6 STRESSING, LOAD TESTING, AND ACCEPTANCE

6.1 GENERAL

A. Each ground anchor shall be tested. No load greater than ten (10) percent of the design load can be applied to the ground anchor prior to testing. The maximum test load shall be no less than 1.33 times the design load and shall not exceed 80 percent of the specified minimum ultimate tensile strength (SMTS) of the prestressing steel of the tendon. The test load shall be simultaneously applied to the entire tendon. Stressing of single elements of multi-element tendons shall not be permitted.

6.2 STRESSING EQUIPMENT

A. The testing equipment shall consist of:
1. A dial gauge or vernier scale capable of measuring to the nearest 0.001 inch shall be used to measure the ground anchor movement. The movement-measuring device shall have a minimum travel equal to the theoretical elastic elongation of the total anchor length at the maximum test load and it shall have adequate travel so the ground anchor movement can be measured without resetting the device at an interim point.
2. A hydraulic jack and pump shall be used to apply the test load. The jack and a calibrated primary pressure gauge shall be used to measure the applied load. The jack and primary pressure gauge shall be calibrated by an independent firm as a unit. The calibration shall have been performed within forty-five (45) working days of the date when the calibration submittals are provided to the Engineer. Testing cannot commence until the Engineer has approved the calibration. The primary pressure gauge shall be graduated in 100 psi increments or less. The ram travel shall be at least 6 inches and preferably not be less than the theoretical elongation of the tendon at the maximum test load. If elongations greater than 6 inches are required, restroking can be allowed.
3. A calibrated reference pressure gauge shall also be kept at the site to periodically check the production (i.e., primary pressure) gauge. The reference gauge shall be calibrated with the test jack and primary pressure gauge. The reference pressure gauge shall be stored indoors and not subjected to rough treatment.
4. The Contractor shall provide an electrical resistance load cell and readout to be used when performing an extended creep test.
5. The stressing equipment shall be placed over the ground anchor tendon in such a manner that the jack, bearing plates, load cells and stressing anchorage are axially aligned with the tendon and the tendon is centered within the equipment.

B. The stressing equipment, the sequence of stressing and the procedure to be used for each stressing operation shall be determined at the planning stage of the project. The equipment shall be used strictly in accordance with the manufacturer's operating instructions.

C. Stressing equipment shall preferably be capable of stressing the whole tendon in one stroke to the specified Test Load and the equipment shall be capable of stressing the tendon to the maximum specified Test Load within 75 percent of the rated capacity. The pump shall be capable of applying each load increment in less than 60 seconds.

D. The equipment shall permit the tendon to be stressed in increments so that the load in the tendon can be raised or lowered in accordance with the test specifications, and allow the anchor to be lift-off tested to confirm the lock-off load.

E. Stressing equipment shall be recently calibrated within an accuracy of plus or minus two (2) percent prior to use. The calibration certificate and graph shall be available on site at all times. The calibration shall be traceable to the National Institute of Standards and Technology (NIST).

6.3 LOAD TESTING SETUP

A. Dial gauges shall bear on the pulling head of the jack and their stems shall be coaxial with the tendon direction. The gauges shall be supported on an independent, fixed frame, such as a tripod, which will not move as a result of stressing or other construction activities during the operation.

B. Prior to setting the dial gauges, the Alignment Load (AL) shall be accurately placed on the tendon. The magnitude of AL depends on the type and length of the tendon.

C. Regripping of strands, which would cause overlapping wedge bites, or wedge bites on the tendon below the anchor head, shall be avoided.

D. Stressing and testing of multiple element tendons with single element jacks is not permitted.

E. Stressing shall not begin before the grout has reached adequate strength.

6.4 PERFORMANCE TESTS

A. Five (5) percent of the ground anchors or a minimum of three (3) ground anchors, whichever is greater, shall be performance tested in accordance with the procedures described below. The Engineer shall select the ground anchors to be performance tested. The remaining ground anchors shall be tested in accordance with the proof test procedures (see Part 6.05).

B. The performance test shall be made by incrementally loading and unloading the ground anchor in accordance with the schedule provided. The load shall be raised from one increment to another immediately after recording the ground anchor movement. The ground anchor movement shall be measured and recorded to the nearest 0.001 inch with respect to an independent fixed reference point at the alignment load and at each increment of load. The load shall be monitored with the primary pressure gauge. The reference pressure gauge shall be placed in series with the primary pressure gauge during each performance test. If the load determined by the reference pressure gauge and the load determined by the primary pressure gauge differ by more than ten (10)

percent, the jack, primary pressure gauge and reference pressure gauge shall be recalibrated at no expense to the Owner. At load increments other than the maximum test load, the load shall be held just long enough to obtain the movement reading.

C. The maximum test load in a performance test shall be held for ten (10) minutes. A load cell shall be used to monitor small changes in load during constant load-hold periods.

STEPS FOR THE PERFORMANCE TEST

Step	Loading	Applied Load	Record and Plot Total Movement (δ_{ti})	Record and Residual Movement (δ_{ri})	Calculate Elastic Movement (δ_{ci})
1	Apply Alignment Load (AL)				
2	Cycle 1	0.25DL	δ_{t1}		
		AL		δ_{r1}	δ_{t1}- δ_{r1}=δ_{e1}
3	Cylcle 2	0.25DL	δ_2		
		0.50DL	δ_{t2}		
		AL		δ_{r2}	δ_{t2}- δ_{r2}=δ_{e2}
4	Cycle 3	0.25DL	δ_3		
		0.50DL	δ_3		
		0.75DL	δ_{t3}		
		AL		δ_{r3}	δ_{t3}- δ_{r3}=δ_{e3}
5	Cycle 4	0.25DL	δ_4		
		0.50DL	δ_4		
		0.75DL	δ_4		
		1.00DL	δ_{t4}		
		AL		δ_{r4}	δ_{t4}- δ_{r4}=δ_{e4}
6	Cycle 5	0.25DL	δ_5		
		0.50DL	δ_5		
		0.75DL	δ_5		
		1.00DL	δ_5		
		1.20DL	δ_{t5}		
		AL		δ_{r5}	δ_{t5}- δ_{r5}=δ_{e5}
7	Cycle 6	0.25DL	δ_6		
		0.50DL	δ_6		
		0.75DL	δ_6		
		1.00DL	δ_6		
		1.20DL	δ_6		
		1.33 DL	δ_{t6}, zero reading for creep test		
8	Hold load for 10 minutes while recording movement at specified times. If the total movement measured during the load hold exceeds the specified maximum value then the load hold should be extended to a total of 60 minutes.				
9	Cycle 6 cont'd.	AL			
Notes: AL = Alignment Load, DL = Design Load, δ_i = total movement at a load other than maximum for cycle, i = number indentifying a specific load cycle.					

D. The jack shall be adjusted as necessary in order to maintain a constant load. The load-hold period shall start as soon as the maximum test load is applied and the ground anchor movement, with respect to a fixed reference, shall be measured and recorded at 1 minute, 2, 3, 4, 5, 6 and 10 minutes. If the ground anchor movement between one (1) minute and ten (10) minutes exceeds 0.04 inch, the maximum test load shall be held for

an additional 50 minutes. If the load hold is extended, the ground anchor movement shall be recorded at 15 minutes, 20, 30, 40, 50 and 60 minutes.

6.5 PROOF TESTS

A. The proof test shall be performed by incrementally loading the ground anchor in accordance with the following schedule. The load shall be raised from one increment to another immediately after recording the ground anchor movement. The ground anchor movement shall be measured and recorded to the nearest 0.001 inch with respect to an independent fixed reference point at the alignment load and at each increment of load. The load shall be monitored with the primary pressure gauge. At load increments other than the maximum test load, the load shall be held just long enough to obtain the movement reading.

PROOF TEST SCHEDULE

Step	Load
1	AL
2	0.25DL
3	0.50DL
4	0.75DL
5	1.00DL
6	1.20DL
7	1.33DL
8	Reduce to lock-off load
9	AL (optional)
10	Adjust to lock-off load

B. The maximum test load in a proof test shall be held for ten (10) minutes. The jack shall be adjusted as necessary in order to maintain a constant load. The load-hold period shall start as soon as the maximum test load is applied and the ground anchor movement with respect to a fixed reference shall be measured and recorded at 1 minute, 2, 3, 4, 5, 6 and 10 minutes. If the ground anchor movement between one (1) minute and ten (10) minutes exceeds 0.04 inch, the maximum test load shall be held for an additional 50 minutes. If the load hold is extended, the ground anchor movements shall be recorded at 15 minutes, 20, 30, 40, 50 and 60 minutes.

6.6 EXTENDED CREEP TESTS

A. The Owner shall determine if extended creep testing is required and select those ground anchors that are to be creep tested. If creep tests are required, at least two (2) ground anchors shall be creep tested. The stressing equipment shall be capable of measuring and maintaining the hydraulic pressure within 50 psi.

B. The extended creep test shall be made by incrementally loading and unloading the ground anchor in accordance with the performance test schedule provided in Section 6.04. At the end of each loading cycle, the load shall be held constant for the observation period indicated in the creep test schedule below. The times for reading and recording the ground anchor movement during each observation period shall be 1 minute, 2, 3, 4, 5, 6, 10, 15, 20, 25, 30, 45, 60, 75, 90, 100, 120, 150, 180, 210, 240, 270 and 300 minutes as appropriate for the load increment. Each load-hold period shall start as soon as the test load is applied. In a creep test, the primary pressure gauge and reference pressure gauge will be used to measure the applied load and the load cell will be used to monitor small changes in load during constant load-hold periods. The jack shall be

adjusted as necessary in order to maintain a constant load.

C. The Contractor shall plot the ground anchor movement and the residual movement measured in an extended creep test. The Contractor shall also plot the creep movement for each load hold as a function of the logarithm of time.

EXTENDED CREEP TEST SCHEDULE

Load	Observation period (min.)
AL	
0.25DL	10
0.50DL	30
0.75DL	30
1.00DL	45
1.20DL	60
1.33DL	300

6.7 GROUND ANCHOR ACCEPTANCE CRITERIA

A. A performance-tested or proof-tested ground anchor with a 10 minute load hold shall be acceptable if the: (1) ground anchor resists the maximum test load with less than 1 mm of movement between 1 minute and 10 minutes; and (2) total elastic movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

B. A performance-tested or proof-tested ground anchor with a 60 minute load hold shall be acceptable if the: (1) ground anchor resists the maximum test load with a creep rate that does not exceed 0.08 inch in the last log cycle of time; and (2) total elastic movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

C. A ground anchor subjected to extended creep testing is acceptable if the: (1) ground anchor resists the maximum test load with a creep rate that does not exceed 0.08 inch in the last log cycle of time; and (2) total elastic movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

D. The initial lift-off reading shall be within plus or minus five (5) percent of the designed lock-off Load. If this criterion is not met, then the tendon load shall be adjusted accordingly and the initial lift-off reading repeated.

6.8 PROCEDURES FOR ANCHORS FAILING ACCEPTANCE CRITERIA

A. Anchors that do not satisfy the minimum apparent free length criteria shall be either rejected and replaced at no additional cost to the Owner or locked off at not more than 50 percent of the maximum acceptable load attained. In this event, no further acceptance criteria are applied.

B. Regroutable anchors which satisfy the minimum apparent free length criteria but which fail the extended creep test at the test load may be postgrouted and subjected to an enhanced creep criterion. This enhanced criterion requires a creep movement of not more than 0.04 inch between 1 and 60 minutes at test load. Anchors which satisfy the enhanced creep criterion shall be locked off at the design lock-off load. Anchors which cannot be postgrouted or regroutable anchors that do not satisfy the enhanced creep

criterion shall be either rejected or locked off at 50% of the maximum acceptable test load attained. In this event, no further acceptance criteria are applied. The maximum acceptable test load with respect to creep shall correspond to that where acceptable creep movements are measured over the final log cycle of time.

C. In the event that an anchor fails, the Contractor shall modify the design and/or construction procedures. These modifications may include, but are not limited to, installing additional anchors, modifying the installation methods, reducing the anchor design load by increasing the number of anchors, increasing the anchor length, or changing the anchor type. Any modification of design or construction procedures shall be at no change in the contract price. A description of any proposed modifications must be submitted to the Engineer in writing. Proposed modifications shall not be implemented until the Contractor receives written approval from the Engineer.

6.9 ANCHOR LOCK-OFF

A. After testing has been completed, the load in the tendon shall be such that after seating losses (i.e., wedge seating), the specified lock-off load has been applied to the anchor tendon.

B. The magnitude of the lock-off load shall be specified by the Engineer, and shall not exceed 70% Fpu.

C. The wedges shall be seated at a minimum load of 50% Fpu. If the lock-off load is less than 50% Fpu, shims shall be used under the wedge plate and the wedges seated at 50% Fpu. The shims shall then be removed to reduce the load in the tendon to the desired lock-off load. Bar tendons may be locked off at any load less than 70% Fpu.

6.10 ANCHOR LIFT-OFF TEST

A. After transferring the load to the anchorage, and prior to removing the jack, a lift-off test shall be conducted to confirm the magnitude of the load in the anchor tendon. This load is determined by reapplying load to the tendon to lift off the wedge plate (or anchor nut) without unseating the wedges (or turning the anchor nut). This moment represents zero time for any long time monitoring.

PART 7 MEASUREMENT AND PAYMENT

A. The quantity of ground anchors to be paid for will be the number of ground anchors installed and accepted. No change in the number of ground anchors to be paid for will be made because of the use by the Contractor of an alternative number of ground anchors. The quantity of performance and extended creep tests to be paid for will be the number of tests performed.

B. The quantity as determined above will be paid for at the contract price per unit of measurement for the particular pay item listed below and shown in the bid schedule, which price and payment will be full compensation for the cost of furnishing all labor, equipment and material required to complete the work described in this section.

C. Payment will be made under:

Pay Item	Pay Unit
Ground Anchors Furnished and Installed:	Lump Sum
Performance Test:	Lump Sum
Extended Creep Test:	Each

END OF SECTION

SECTION 02513 – ASPHALT CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes asphalt concrete paving work.

B. Related Sections: Prepared aggregate subbase is specified in earthwork section.

1.2 SUBMITTALS:

A. Material Certificates: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Comply with State highway or transportation department standard specifications, latest edition, and with local governing regulations if more stringent than herein specified.

1.4 SITE CONDITIONS:

A. Weather Limitations: Apply prime and tack coats when ambient temperature is above 50 deg.F (10 deg.C), and when temperature has not been below 35 deg.F (1 deg.C) for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.
   1. Construct asphalt concrete surface course when atmospheric temperature is above 50 deg.F (4 deg.C), and when base is dry. Base course may be placed when air temperature is above 30 deg. F (-1 deg.C) and rising.

B. Grade Control: Establish and maintain required lines and elevations.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Use locally available materials and gradations, which exhibit a satisfactory record of previous installations.

B. Base Course Aggregate: Sound, non-expansive angular crushed stone, crushed gravel, or crushed slag, sand, stone or slag screenings, 3/4" Gradation. Recycled asphalt can also be used for road base if crushed to meet the gradation table in 2.1.C.
   1. Uncrushed gravel may be used in base course mixture if required to suit local material availability.

C. 3/4" Gradation Table

Sieve Size	Ideal Gradation (Percent Passing)	Ideal Gradation Tolerance (Percent)
3/4"	100	
3/8"	85	+/- 7
No. 4	61	+/- 6
No. 16	33	+/- 5
No. 200	9	+/- 2

D. Base Course Thickness: to be not less than 6-inches and as shown on detail sheet.

E. Surface Course Aggregate: Crushed stone, crushed gravel, crushed slag, and sharp-edged natural sand.

F. Sand prepared from stone, blast-furnace slag, or gravel, or combinations thereof may be used if required to suit local material availability.

G. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M 17 (ASTM D 242).

H. Asphalt Cement: AASHTO M 226 (ASTM D 3381) for viscosity-graded material and AASHTO M 20 (ASTM D 946) for penetration-graded material.

I. Prime Coat: Cut-back asphalt type; AASHTO M 82 (ASTM D 2027) MC-30, MC-70 or MC-250.

J. Tack Coat: Emulsified asphalt, AASHTO M 140 (ASTM D 997) or M 208 (D 2397); SS-1 SS-1h, CSS-1 or CSS-1h, diluted with one part water to one part emulsified asphalt.

2.2 ASPHALT-AGGREGATE MIXTURE:

A. Provide plant-mix, hot-laid asphalt-aggregate mixture complying with ASTM D 3515 and as recommended by local paving authorities to suit project conditions.

B. Provide minimum compacted asphalt thickness of 3.5-inches and as shown on detail sheet. Place asphalt in two lifts with a minimum thickness of not less than 1.5”. Do not exceed a compacted thickness of 3-inches per lift.

C. The percentage of bituminous material by weight added to aggregate will be between 4% and 7% of the weight of the bituminous mixture. Aggregate gradation shall be as follows:

Sieve Size	Ideal Gradation (Percent Passing)	Tolerance
3/4"	100	
1/2"	91	+/- 5
3/8”	83	+/- 8
No. 4	54	+/- 8
No. 16	28	+/- 6
No. 50	17	+/- 6
No. 200	5	+/- 2

PART 3 - EXECUTION

3.1 SURFACE PREPARATION:

A. Remove loose material from compacted base coarse surface immediately before applying herbicide treatment or prime coat.
   1. Proof roll prepared base coarse surface to check for unstable areas and areas requiring additional compaction.

   2. Notify Engineer of unsatisfactory conditions. Do not begin paving work until deficient base coarse areas have been corrected and are ready to receive paving.

B. Herbicide Treatment: Not used.

C. Prime Coat: Not used.

D. Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland Cement Concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gal. per sq. yd. of surface.
   1. Allow drying until at proper condition to receive paving.
   2. Exercise care in applying bituminous materials to avoid smearing on adjoining concrete surfaces. Remove or clean damaged surfaces at discretion of architect.

3.2 PLACING MIX:

A. General: Place asphalt concrete mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of 225 deg.F (107 deg.C). Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness.

B. Paver Placing: Place in strips not less than 10' wide, unless otherwise acceptable to Engineer. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.

C. Joints: Make joints between old and new pavements or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

D. Asphalt adjacent to concrete curb and gutter, concrete waterways, catch basins or other drainage structures shall be compacted to an elevation of 1/4 inch above adjacent drainage structure (edge of concrete) except open face curb and gutter. Place asphalt even with the lip on open face curb and gutter.

3.3 COMPACTION:

A. Percentage of Maximum Density Requirements: Compact asphalt to not less than 95% of maximum laboratory density determined in accordance with ASTM D-2726-83 or ASTM D-1188-83.

3.4 ROLLING:

A. General: Begin rolling when mixture will bear roller weight without excessive displacement.

1. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

B. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.

C. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

D. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

E. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened, or 24 hours, whichever is longer.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.5 FIELD QUALITY CONTROL:

A. Test in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Engineer.

B. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:
1. Base Course: 1/2-inch, plus or minus.
2. Surface Course: 1/4-inch, plus or minus.

C. Base Course Testing: Owner shall employ testing laboratory to perform at least one density test on aggregate base course for each 200 c.y. (1200 s.y. at 6-inch) of material placed.

D. Asphalt Testing: Owner shall employ testing laboratory to perform at least one (1) coring sample of asphalt taken for every 100 C.Y. (1200 S.Y. at 3-inches) of asphalt installed to verify asphalt density, temperature and thicknesses are in conformance with specifications. The testing agency shall locate coring sites for owner. The asphalt contractor is responsible for repair of core holes. Owner shall employ testing laboratory to provide laboratory testing for materials check on bituminous materials, including but not limited to: gradation, extraction, compaction, marshall density, stability, flow and % AC.

E. Surface Smoothness: Test finished surface of each asphalt concrete courses for smoothness, using 10-foot straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness.
1. Base Course Surface: 1/4-inch.
2. Wearing Course Surface: 3/16-inch.
3. Check surface areas at intervals as directed by Engineer.

END OF SECTION 02513

SECTION 02514 – PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes Portland cement concrete paving
1. Concrete Pavement
2. Valve Box Collars
3. Concrete Pads

B. Related Sections:
1. Prepared subbase is specified in "Earthwork" section.
2. Concrete and related materials are specified in Division 3.
3. Joint fillers and sealers are specified in Division 7.

1.2 QUALITY ASSURANCE:

A. Codes and Standards: Comply with local governing regulations if more stringent than herein specified.

1.3 SUBMITTALS:

A. Furnish samples, manufacturer's product data, test reports, and materials certifications as required in referenced sections for concrete and joint fillers and sealers.

1.4 JOB CONDITIONS:

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
1. Use flaggers, barricades, warning signs and warning lights as required.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. Curing Compound:
a. "A-H 3 Way Sealer"; Anti-Hydro Waterproofing Co.
b. "Ecocure"; Euclid Chemical Co.
c. "Sure Cure"; Kaufman Products Inc.
d. "Kure-N-Seal"; Sonneborn-Contech.
e. "L&M Cure"; L & M Construction Chemicals.

2. Bonding Compound:
a. "J-40 Bonding Agent"; Dayton Superior Corp.
b. "Everbond"; L & M Construction Co.
c. "Sonocrete"; Sonneborn-Contech.
d. "Acrylic Bondcrete"; The Burke Co.

3. Bonding Adhesive:
   a. "Epoxtite"; A.C. Horn.
   b. "Edoco 2118 Epoxy Adhesive"; Edoco Technical Prod.
   c. "Silkadur Hi-Mod"; Sika Chemical Corp.
   d. "Euco Epoxy 463 or 615"; Euclid Chemical Co.
   e. "Patch and Bond Epoxy"; The Burke Co.
   f. "Sure-Poxy"; Kaufman Products Inc.

2.2 MATERIALS

A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal.
   1. Forms shall be straight free of distortion and defects.
   2. Use flexible spring steel forms or laminated boards to form radius bends as required.
   3. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.

B. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.
   1. Metal Expansion Caps: Furnish on one end of each dowel bar in expansion joints. Design caps with one end closed and a minimum length of 3" to allow bar movement of not less than 1", unless otherwise indicated.

C. Concrete Materials: Comply with requirements of applicable Division 3 sections for concrete materials, admixtures, bonding materials, curing materials, and others as required.

D. Expansion Joint Materials: Comply with requirements of applicable Division 7 sections for preformed expansion joint fillers and sealers.

E. Anti-Spalling Compound: 50% (by volume) boiled linseed oil and 50% (by volume) mineral spirits, complying with AASHTO M-233.

F. Liquid-Membrane Forming Curing Compound: Complying with ASTM C 309, Type I, Class A unless other type acceptable to Architect. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq. ft./gal.

G. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type.

H. Epoxy Adhesive: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

2.3 CONCRETE MIX, DESIGN AND TESTING:

A. Comply with requirements of applicable Division 3 sections for concrete mix design, sampling and testing, and quality control, and as herein specified.

B. Design mix to produce standard-weight concrete consisting of portland cement, aggregate, water-reducing or high-range water- reducing admixture (super-plasticizer), air-entraining admixture and water to produce the following properties:
   1. Compressive Strength: 4000 psi, minimum at 28 days.
   2. Slump Range: 8" for concrete containing HRWR admixture (super-plasticizer); 3" for other concrete.

3. Air Content: 5% to 8%.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION:

A. Remove loose material from compacted subbase surface immediately before placing concrete.

B. Proof-roll prepared subbase surface to check for unstable areas and re-compact as required. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

3.2 FORM CONSTRUCTION:

A. Set forms to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

B. Check completed formwork for grade and alignment to following tolerances:
1. Top of forms not more than 1/8" in 10'.
2. Vertical face on longitudinal axis, not more than 1/4" in 10'.
3. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

3.3 CONCRETE PLACEMENT:

A. Comply with requirements of Division 3 sections for mixing and placing concrete, and as herein specified.

B. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if necessary to provide a uniform dampened condition at time concrete is placed.

C. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

1. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surface.
2. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2-hour, place a construction joint.
3. When adjacent pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained sufficient strength to carry loads without injury.

3.4 JOINTS:

A. Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles

to the centerline, unless otherwise indicated.

4. When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas 12 ft. wide by 12 ft. long unless shown on drawings. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness, as follows:

C. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.

D. Sawed Joints: Form weakened-plane joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.

E. Inserts: Use embedded strips of metal or sealed wood to form weakened-plane joints. Set strips into plastic concrete and carefully remove strips after concrete has hardened.

F. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 1/2-hour, except where such pours terminate at expansion joints. Construct joints as shown or, if not shown, use standard metal keyway-section forms.

G. Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated.

1. Locate expansion joints at 50' o.c. for each pavement lane, unless otherwise indicated.
2. Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated.
3. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.
4. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

H. Fillers and Sealants: Comply with the requirements of applicable Division 7 sections for preparation of joints, materials, installation, and performance.

3.5 CONCRETE FINISHING:

A. After striking-off and consolidating walkway concrete, smooth surface by screeding and floating. At parking and driveway concrete, smooth surface by bull-float only. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

B. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

C. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2" radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

D. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
   1. Broom finish, by drawing a fine-hair broom across concrete surface, perpendicular to line of traffic. Repeat operation if required to provide a fine line texture acceptable to Architect.
   2. On inclined slab surfaces, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic.
   3. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Architect.

3.6 CURING:

A. Protect and cure finished concrete paving, complying with applicable requirements of Division 3 sections. Use membrane- forming curing and sealing compound or approved moist-curing methods.

B. Anti-Spalling Treatment: A second coat of curing and sealing compound may be used or an anti-spalling compound applied over concrete cured by continuous moist curing methods. Apply compounds to concrete surfaces no sooner than 28 days after placement, to clean, dry concrete free of oil, dirt, and other foreign material. Apply curing and sealing compound at a maximum coverage rate of 300 sq. ft./gallon. Apply anti-spalling compound in two sprayed applications. First application at rate of 40 sq. yds. per gal; second application, 60 sq. yds. per gallon. Allow complete drying between applications.

3.7 REPAIRS AND PROTECTIONS:

A. Repair or replace broken or defective concrete, as directed by Architect.

B. Drill test cores where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
   1. Sweep concrete pavement and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

3.8 FIELD QUALITY CONTROL

A. The Owner will employ a testing laboratory to perform sampling and testing of concrete only in accordance with Section 03310 with the following exception:
   1. Compressive strength tests shall be obtained at a rated of one set of four (4) per 150 yards of concrete placement or a minimum of one set of four (4) for each day's concrete placement.

END OF SECTION 02514

SECTION 02530 – SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sanitary sewage systems.
1. Coordinate connection of sanitary sewer system with Hooper City Vacuum Sewer Collection System.

B. Related Sections:
1. Refer to Division-2 section "Earthwork" for excavation and backfill required for sanitary sewage systems; not work of this section.
2. Refer to Division-15 section "Soil and Waste Systems" for interior building systems including drain, waste, and vent piping; not work of this section.

1.2 QUALITY ASSURANCE:

A. Codes and Standards:
1. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of sanitary sewage system materials and products.
2. State of Utah DEQ Compliance: Comply with State of Utah requirements, Rule 317-4 for sanitary sewer systems.

1.3 SUBMITTALS:

None

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Acceptable Manufacturer: Subject to compliance with requirements, provide products of one of the following:
1. Line Markers:
a. American Marking Corp.
b. Emed Co., Inc.
c. Seton Name Plate Corp.

2.2 IDENTIFICATION:

A. Underground-Type Plastic Line Markers: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide green tape with black printing reading "CAUTION SEWER LINE BURIED BELOW".

2.3 PIPES AND PIPE FITTINGS:

A. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.

1. Cast-Iron Soil Pipe: ASTM A 74, hub and spigot ends, service weight unless otherwise indicated.
   a. Fittings: Cast-iron hub and spigot ends, standard strength unless otherwise indicated.
2. Polyvinyl Chloride (PVC) Sewer Pipe: ASTM D 3034, Type PSM, SDR 35.
   a. Fittings: ASTM 3034, bell and spigot joints.

2.4 SANITARY SEWER MANHOLES:

A. Provide precast reinforced concrete sanitary manholes as indicated, and complying with ASTM C 478.
   1. Top: Precast concrete, of concentric cone, eccentric cone, or flat slab top type, as indicated.
   2. Base: Precast concrete, with base riser section and separate base slab, or base riser section with integral floor, as indicated.
   3. Steps: Ductile-iron or aluminum, integrally cast into manhole sidewalls.
   4. Frame and Cover: Ductile-iron, heavy-duty, indented top design, with lettering cast into top reading "SANITARY SEWER".
   5. Pipe Connectors: Resilient, complying with ASTM C 923.

2.5 CLEANOUTS:

A. Pipe extension to grade with ferrule and countersunk cleanout plug. Round cast-iron access frame over cleanout, with heavy-duty secured scoriated cover with lifting device in a concrete collar.

PART 3 - EXECUTION

3.1 INSTALLATION OF IDENTIFICATION:

A. During back-filling/top-soiling of sanitary sewage systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below sub grade.

3.2 INSTALLATION OF PIPE AND FITTINGS:

A. Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.
   1. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.
   2. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.
   3. Place bell ends or groove ends of piping facing upstream.
   4. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.

B. Pipe:
   1. Cast-Iron Pipe: Install in accordance with applicable provisions of CISPI "Cast Iron Soil Pipe and Fittings Handbook".
   2. Plastic Pipe: Install in accordance with manufacturer's installation recommendations, and in accordance with ASTM D 2321.

C. Cleaning Pipe: Clear interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed.
   1. In large, accessible piping, brushes and brooms may be used for cleaning.
   2. Place plugs in ends of uncompleted conduit at end of day or whenever work stops.
   3. Flush lines between manholes if required to remove collected debris.

D. Joint Adapters: Make joints between different types of pipe with standard manufactured adapters and fittings intended for that purpose.

E. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
   1. Make inspections after lines between manholes, or manhole locations, have been installed and approximately 2-ft of backfill is in place, and again at completion of project.
   2. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects, and reinspect.

3.3 SANITARY MANHOLES:

A. Place precast concrete sections as indicated. Where manholes occur in pavements, set tops of frames and covers flush with finish surface. Elsewhere, set tops 3" above finish surface, unless otherwise indicated.
   1. Install in accordance with ASTM C 891.
   2. Apply bituminous mastic coating at joints of sections.

3.4 TAP CONNECTIONS:

A. Make connections to existing piping and underground structures, so that finished work will conform as nearly as practicable to requirements specified for new work.

B. Use commercially manufactured wyes for branch connections. Field cutting into piping will not be permitted.

C. Take care while making tap connections to prevent concrete or debris from entering existing piping or structure. Remove debris, concrete, or other extraneous material which may accumulate.

3.5 BACKFILLING:

A. Conduct backfilling operations of open-cut trenches closely following laying, jointing, and bedding or pipe, and after initial inspection and testing are completed.

3.6 FIELD QUALITY CONTROL:

A. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction.

END OF SECTION 02530

SECTION 02666 – POTABLE WATER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes potable water systems work.

B. Related Sections:
1. Refer to Division-2 section "Earthwork for Site" for excavation and backfill required for potable water systems; not work of this section.
2. Refer to Division-3 sections for concrete work required for potable water systems; not work of this section.
3. Refer to Division-15 section "Potable Water Systems" for interior building systems including interior piping, fixtures, and equipment; not work of this section.

1.2 QUALITY ASSURANCE:

A. Codes and Standards:
1. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of potable water system materials and products.
2. Water Purveyor Compliance: Comply with requirements of Purveyor (Hooper Water Improvement District) supplying water to project, obtain required permits and inspections.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for potable water system materials and products.

B. Maintenance Data: Submit maintenance data and parts list for potable water system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Approved Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. Plastic line markers
   a. American Marking Corp.
   b. Seton Name Plate Corp.
2. Gate Valves:
   a. Clow Corp; Valve Div.
   b. Dresser Mfg.; Div. of Dresser Industries.
   c. Fairbanks Co.
   d. Kennedy Valve; Div. of ITT Grinnell Valve Co. Inc.
   e. Stockham Valves and Fittings Inc.
   f. Waterous Co.

3. Yard Hydrants
   a. Josam Mfg. Co.
   b. Smith (Jay R.) Mfg. Co.
   c. Tyler Pipe.
   d. Zurn Industries, Inc.; Hydromechanics Div.

2.2 IDENTIFICATION:

A. Underground-Type Plastic Line Markers: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide blue tape with black printing reading "CAUTION WATER LINE BURIED BELOW".

B. Nonmetallic Piping Label: If nonmetallic piping is used for water service, provide engraved plastic laminate, label permanently affixed to main electrical meter panel stating "THIS STRUCTURE HAS A NONMETALLIC WATER SERVICE".

2.3 PIPES AND PIPE FITTINGS:

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in potable water systems. Where more than one type of materials or products are indicated, selection is Installer's option.

B. Piping: Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.
   1. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 80 pipe, with plain ends for solvent-cemented joints with ASTM D 2467, Schedule 80, socket-type fittings
   2. PVC Pipe: Ultra Blue AWWA C909 Class 200 Pipe with ductile iron fittings.

2.4 VALVES:

A. Gate Valves: AWWA C500, 175 psi working pressure, threaded, flanged, hub, or other end configurations to suit size of value and piping connection. Provide inside screw type for use with curb valve box, iron body, bronze-mounted, double disc, parallel seat, non-rising stem.

2.5 ACCESSORIES:

A. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.
   1. Clamps, Straps, and Washers: Steel, ASTM A 506.
   2. Rods: Steel, ASTM A 575.
   3. Rod Couplings: Malleable-iron, ASTM A 197.
   4. Bolts: Steel, ASTM A 307.
   5. Cast-Iron Washers: Gray-iron, ASTM A 126.
   6. Thrust Blocks: Concrete, 2,500 psi.

7. Yard Hydrants: Non-freeze yard hydrants, inlet and outlet as inidicated, bronze casing, cast-iron or cast-aluminum casing guard, key-operated, and tapped drain port in valve housing.
8. Valve Pits: Valve pits as indicated, constructed of poured-in-place or precast concrete. Construct of dimensions indicated with manhole access, ladder, and drain. Provide sleeves for pipe entry and exit, provide waterproof sleeve seals.
9. Valve Boxes: 2 piece, cast iron, screw adjustable sleeves, 5-1/4 inch shaft, with drop lid.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which potable water system's materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF IDENTIFICATION:

A. During back-filling/top-soiling of underground potable water piping, install continuous underground-type plastic line markers, located directly over buried lines at 6" to 8" below sub grade

3.3 INSTALLATION OF PIPE AND PIPE FITTINGS:

A. Pipe:
1. Install PVC pressure piping according to AWWA M23 or ASTM D 2774 and ASTM F 1668 and in accordance with instructions from water purveyor.
2. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668

B. Depth of Cover: Provide minimum cover over piping of 12" below average local frost depth or 428" below finished grade, whichever is greater.

C. Water Main Connection: Arrange and pay for tap in water main, of size and in location as indicated, from water Purveyor.

D. Water Service Termination: Terminate potable water piping 5'-0" from building foundation in location and invert as indicated. Provide temporary pipe plug for piping extension into building, by work of Division 15.
1. Mark location with surface marker.

3.4 INSTALLATION OF VALVES:

A. Install valves with stems pointing up. Provide valve box over underground valves.

3.5 FIELD QUALITY CONTROL:

A. Piping Tests: Conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened. Fill pipeline 24-hrs. prior to testing, and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than 200 pounds per square inch for 2-hrs.
   1. Test fails if leakage exceeds 2-qts per hour per 100 gaskets or joints, irrespective of pipe diameter.
   2. Increase pressure in 50 psi increments and inspect each joint between increments. Hold at test pressure for one hour, decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour.

3.6 ADJUSTING AND CLEANING:

A. Disinfection of Potable Water System: Flush pipe system with clean potable water until no dirty water appears at point of outlet. Fill system with water-chlorine solution containing at least 50 ppm of chlorine. Valve off system and let stand for 24- hrs minimum. Flush with clean potable water until no chlorine remains in water coming from system.
   1. Repeat procedure if contamination is present in bacteriological examination.

B. Disinfection of Water Mains: Flush and disinfect in accordance with AWWA C651 "Standard for Disinfecting Water Mains".
   1. Contractor shall submit written verification to Project Manager stating, Disinfection has been completed in strict compliance with specification for this project and with jurisdiction having authority over water system.

END OF SECTION 02666

SECTION 02720 – STORM SEWERAGE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes storm sewage systems.

B. Related Sections:
1. Refer to Division-2 section "Earthwork" for excavation and backfill required for storm sewage systems; not work of this section.
2. Refer to Division-3 sections for concrete work required for storm sewage systems; not work of this section.
3. Refer to Division-15 section "Storm Water Systems" for interior building systems including conductors, horizontal branches, and connections to roof and deck drains; not work of this section.
4. Refer to Section 02200 “Earthwork” for information regarding percolation tests.

1.2 QUALITY ASSURANCE:

A. Codes and Standards:
1. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of storm sewage system's materials and products.
2. Environmental Compliance: Comply with applicable portions of local Environmental Agency regulations pertaining to storm sewage systems.
3. National Pollution Discharge Elimination System (NPDES) Compliance: Comply with NPDES requirements and Storm Water Pollution Prevention Plan (SWPPP).

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Approved Manufacturers: Subject to compliance with requirements, provide products of one of the following:
1. Identification Markers
a. Allen Systems Inc.
b. Emed Co., Inc.
c. Seton Mane Plate Corp.

2.2 IDENTIFICATION:

A. Underground-Type Plastic Line Markers: Manufacturer’s standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide green tape with black printing reading "CAUTION STORM SEWER LINE BURIED BELOW".

2.3 PIPES AND PIPE FITTINGS:

A. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.
1. Polyvinyl Chloride (PVC) Sewer Pipe: ASTM D 3034, Type PSM SDR 35 up to 10" diameter pipe.

a. Fitting: PVC ASTM 3034, bell and spigot joints.

2. Reinforced Concrete Pipe: ASTM C 76, Class III unless otherwise indicated.
   a. Fittings: Reinforced concrete, same strength as adjoining pipe, tongue-and-groove gasketed joints complying with ASTM C 443.
3. Concrete Pipe: ASTM C 14, Class III nonreinforced concrete pipe unless otherwise indicated.
   a. Fittings: Concrete, same strength as adjoining pipe, tongue-and-groove gasketed joints complying with ASRM C 443.

2.4 STORM SEWER MANHOLES

A. Provide precast reinforced concrete storm sewer manholes as indicated, complying with ASTM C 478.
   1. Top: Precast concrete, of concentric cone, eccentric cone, or flat slab top type, as indicated.
   2. Base: Precast concrete, with base riser section and separate base slab, or base riser section with integral floor, as indicated. For sumps, precast ring with base riser section as indicated.
   3. Steps: Ductile-iron or aluminum, integrally cast into manhole sidewalls.
   4. Frame and Cover: Ductile-iron, heavy-duty, indented top design, with lettering cast into top reading "STORM SEWER", conforming to ASTM A-48.
   5. Pipe Connections: Resilient, complying with ASTM C 923.

2.5 CATCH BASINS:

A. Precast or cast in place reinforced concrete catch basins as indicated.
   1. Basin: Precast or cast in place reinforced concrete, flat slab top.
   2. Frame and Grate: Ductile-iron or galvanized steel grate, heavy- duty, bicycle proof.
   3. Pipe Connectors: Resilient, complying with ASTM C 923.

PART 3 - EXECUTION

3.1 INSTALLATION OF IDENTIFICATION:

A. During back-filling/top-soiling of storm sewage systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below sub grade.

3.2 INSTALLATION OF PIPE AND PIPE FITTINGS:

A. Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.
   1. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.
   2. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.
   3. Place bell ends or groove ends of piping facing upstream.
   4. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.

B. Pipe:
   1. Polyvinyl Chloride (PVC) pipe: Install in accordance with manufacturer's installation recommendations, and in accordance with ASTM D 2321.
   2. Concrete Pipe: Install in accordance with applicable provisions of ACPA

"Concrete Pipe Installation Manual".

C. Cleaning Piping: Clean interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed.
   1. In large, accessible piping, brushes and brooms may be used for cleaning.
   2. Place plugs in ends of uncompleted conduit at end of day or whenever work stops.
   3. Flush lines between manholes if required to remove collected debris.

D. Joint Adapters: Make joints between different types of pipe with standard manufactured adapters and fittings intended for that purpose.

E. Closing Abandoned Utilities: Close open ends of abandoned underground utilities, which are indicated to remain in place. Provide sufficiently strong closures to withstand hydro-static or earth pressure which may result after ends of abandoned utilities have been closed.

F. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of materials being closed. Wood plugs are not acceptable.

G. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
   1. If inspection indicated poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects, and reinspect.

3.3 CATCH BASINS:

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.4 TAP CONNECTIONS:

C. Make connections to existing piping and underground structures, so that finished work will conform as nearly as practicable to requirements specified for new work.

D. Use commercially manufactured wyes for branch connections. Field cutting into piping will not be permitted.
   2. For branch connections from side into existing 24" or larger piping, or to underground structures, cut opening into unit sufficiently large to allow 3" of concrete to be packed around entering connections. Cut ends of connection passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6" of concrete for minimum length of 12" to provide additional support or collar from connection to undisturbed ground.
   3. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
   4. Take care while making tap connections to prevent concrete or debris from entering existing piping or structure. Remove debris, concrete, or other extraneous material, which may accumulate.

C. Connections under the building: use MJ type connections, reducers, tees etc. as needed to connect the roof drain to the storm drain under the building.

3.5 BACKFILLING:

A. Conduct backfill operations of open-cut trenches closely following laying, jointing, and bedding of pipe, and after initial inspection and testing are completed.
   1. To minimize local area traffic interruptions, allow no more than 100' between pipe laying and point of complete backfilling.
   2. Backfill sections under the building or adjacent to footings with structural fill.

3.6 FIELD QUALITY CONTROL:

A. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction.

END OF SECTION 02720

SECTION 02765 – PAVEMENT MARKINGS

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.

B. Section Includes
   1. Painted pavement markings.

C. Related Sections:
   1. Section 02513 – Asphalt Concrete Paving.
   2. Section 02714 – Cement Concrete Paving.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Section 01330.

B. Manufacturer’s product data and installation instructions.

1.3 QUALITY ASSURANCE

A. Installer: Having a minimum of 2 years experience in the layout and striping of parking lots.

B. Job Conditions: Do not apply marking paint when weather is foggy or rainy, or ambient or pavement temperatures are below 40 degrees F., nor when such conditions are anticipated during 8 hours after application.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.5 PROJECT CONDITIONS

A. Environmental Requirements: Apply paint when ambient temperature is 50°F. or above, and relative humidity is below 85%.

B. Do not apply marking paint when weather is foggy or rainy, or ambient or pavement temperatures are below 40 degrees F., nor when such conditions are anticipated during eight hours after application.

C. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.

D. Allow asphalt pavement to cure for 30 days and be dry before starting pavement marking.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Traffic Marking Paint:

1. Type: Solvent borne alkyd resin; durable and weather-resistant; high solids; fast drying; VOC compliant; meeting requirements of Federal Paint Specifications TT-P-115F and TT-P-85E.
2. Application Thickness per Coat: 15 mils wet (7 mils dry).
3. Application Rate per Coat: 300 to 320 linear feet of 4 inches wide line per gallon.
4. Colors:
   a. Yellow: Parking stall stripping, directional emblems, restricted parking zone striping, disabled accessibility paths.
   b. Blue with White Copy: Disabled parking emblems.
   c. Red: Fire lanes.

B. Acceptable Products: Subject to compliance with requirements, provide products by one of the following:
1. S275 Traffic Paint Alkyd 4900 Series by ICI Dulux.
2. Substitutions: Submit in accordance with Section 01600.

2.2 APPLICATION EQUIPMENT

A. Pressurized, self-contained paint machine capable of applying a straight line from 2 to 6 inch wide, with consistent coverage.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Surface Conditions: Clean and dry free from dirt, loose paint, oil, grease, wax, and other contaminants.

B. Locate markings as indicated on Drawings. Provide qualified technician to supervise equipment and application of markings. Lay out markings using guide lines, templates and forms.

C. Do not apply traffic and lane marking paint until layout and placement has been verified with Owner’s Representative

D. Thoroughly clean pavement surfaces free of dirt, sand, gravel, oil and other foreign materials.

E. Allow paving to cure before painting as required by manufacturer of traffic paint.

3.2 APPLICATION

A. Apply in accordance with manufacturer's written instructions.

B. Apply 2 coats to paving.

C. Using approved equipment, apply paint to a minimum thickness of 15 mils. Marking edges of stripes and symbols shall be sharply outlined.

D. Restrict traffic on pavement until stripping is fully cured.

END OF SECTION 02765

SECTION 02822 – CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Chain Link Fences and Gates.
B. Vinyl Slats

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions.

1.3 RELATED SECTIONS

A. Division 1 Specification Sections including, but not limited to following:

1. Section 01335 Shop Drawings, Product Data and Samples.

B. Section 02200 Earthwork.

C. Section 03300 Cast-In-Place Concrete.

D. Section 02831 Horizontal Sliding Gate Operators.

1.4 SUBMITTALS

A. Product data in form of manufacturer's technical data, specifications, and installation instructions for fence and gate posts, fabric, gates, and accessories.

B. Shop drawings showing location of fence, gates, each post, and details of post installation, extension arms, gate swing, hardware, and accessories.

C. NOT USED. Wiring diagrams from manufacturer for electrically operated gates.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage Installed with minimum 5 years' experience and has completed at least 5 chain link fence projects with same material and of similar scope to that indicated for this Project with successful construction record of in-service performance.

B. Single-Source Responsibility: Obtain chain link fences and gates, including accessories, slats, fittings, and fastenings, from single source. Fence installer and gate operator installer are responsible to provide a coordinated and completely operational sliding gate design and installation with selected horizontal gate operator and accessories and functionality requested.

C. Engineering of cantilevered gate is responsibility of gate provider.

1.6 PROJECT CONDITIONS AND PREPARTION FOR FENCING

A. Soil and Rock: See soils report (attached to specifications).

B. Grubbing and Clearing: All vegetation and debris within 3 feet of the new fence line, on both sides, shall be removed by the Contractor. All roots will be removed I the top 10 inches of

soil.

C. Grading: A six-foot wide strip, centered on the new fence line, shall be smoothed and graded, so that no rocks will project above the plane surface more than 1 foot and no depressions will project below the plane surface more than one foot.

1.7 PREPARATION FOR FENCING

A. Field Measurements: Verify layout information for fences and gates indicated on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 FABRIC

A. Steel Chain-Link Fence Fabric: Fabricated in one-piece widths for fencing 12 feet and less in height to comply with Chain Link Fence Manufactures Institute (CLFMIO) "Product Manual" and with requirements indicated below:

1. Mesh and Wire Size: 2-inch mesh, o.120-inch diameter (11 gage).
2. Coating: ASTM A 817, Type 2, Class 1, zinc-coated (galvanized) applied after weaving.

2.2 FRAMING

A. Round member sizes are given in actual outside diameter (OD) to nearest thousandth of inch. Round fence posts and rails are often referred to in ASTM standard specifications by nominal pipe sizes (NPS) or equivalent trade sizes in inches. Following indicates these equivalents all measured in inches:

Actual Outside Diameter (OD)	NPS Size	Trade Size
1.900	1-1/2	2
2.375	2	2-1/2
2.875	2-1/2	3
3.500	3	3-1/2
4.000	3-1/2	4

B. Type I Round Posts: Standard weight (schedule 40) galvanized-steel pipe conforming to ASTM F 1083, according to heavy industrial requirements of ASTM F 669, Group 1A, with minimum yield strength of 25,000 phi, not less than 1.8 ounces of zinc per square foot. Type A coating inside and outside according to ASTM F 1234, as determined by ASTM A 90, and weights per foot as follows:

Actual Outside Diameter (OD)	Weight (pounds per foot)	NPS Size
1.900	2.72	1-1/2
2.375	3.65	2
2.875	5.79	2-1/2
3.500	7.58	3
4.000	9.11	3-1/2

C. Roll-Formed Steel: Rolled form steel shapes (e.g., C section) produced from structural-

quality steel conforming to ASTM A 570, grade 45, or ASTM A 446, grade D, galvanized, conforming to heavy industrial requirements of ASTM F 669, Group II, with minimum yield strength of 45,000 psi. Protective coating system according to ASTM F 1234, Type A, hot-dip galvanized with minimum of 2.0 ounces of zinc per square foot according to ASTMA A 123, 4.0 ounces of zinc per square foot according to ASTM A 525; or Type C, minimum of 1.0 ounce of zinc – 5 percent aluminum-mischmetal alloy per square foot according to ASTM A 875.

D. Roll-Formed Steel: Hot-rolled steel shape H section with minimum yield strength of 45,000 psi conforming to ASTM F 669, group III. Protective coating system according to ASTM F 1234, Type A, hot-dip galvanized with minimum of 2.0 ounces of zinc per square foot according to ASTM A 123, or 4.0 ounces of zinc per square foot according to ASTM A 525.

E. Square Tubing: Cold-formed steel structural tubing conforming to ASTM A 500, Grade B with minimum yield strength of 42,000 psi and not less than 1.8 ounces of zinc per square foot Type A coating inside and outside according to ASTM F 1234, as determined by ASTM A 90.

F. Bottom Rail: Manufacturer's longest lengths (17 to 21 feet) with swedged-end or expansion-type coupling. Approximately 6 inches long for joining. Provide rail ends or other means for attaching rail securely to each gate corner, pull, and end post. Bottom rail shall be 1.90-inch outside diameter Type I and II steel pipe.

G. Steel posts for fabric heights up to (and including) 6 feet:

1. Round Line or Intermediate posts: 3.5-inch outside diameter Type I or II steel Pipe.
2. Round End, Corner, and Pull Posts: 4.0 inches outside diameter Type I or II steel pipe.

H. Swing Gate Posts: Finish posts to support single gate leaf, or 1 leaf of double-gate installation, according to ASTM F 900, sized as follows for fabric up to and including 6 feet and gates up to 10' in width: 4.0 inch OD pipe weighting at least 8.65 pounds per foot.

2.3 FITTINGS AND ACCESSORIES

A. Material: Comply with ASTM F 626. Galvanized iron or steel to suit manufacturer's standards.

1. Steel and Iron: Unless specified otherwise, hot-dip galvanize pressed steel or cast-iron fence fittings and accessories with at least 1.2 ounces zinc per square foot as determined by ASTM A 90.

B. Post and Line Caps: Provide weather tight closure cap for each post. Provide line post caps with loop to receive tension wire.

C. Post Brace Assembly: Manufacturer's standard adjustable brace. Use material specified below for brace, and truss to line posts with 3/8-iknch diameter rod and adjustable tightener. Provide manufacturer's standard galvanized-steel, cast-iron or cast-aluminum cap for each end.

1. Round Steel: 1.900-inch OD Type I or II steel pipe.
2. Roll-Formed Steel: C section weighing minimum o f2.72 pounds per linear foot.

D. Bottom (and Center Rail, if required): 1.900-inch OD Type I or II steel pipe. Provide manufacturer's standard galvanized-steel, cast-iron or cast-aluminum cap for each end.

E. Tension or Stretcher Bars: Hot-dip galvanized steel with minimum length 2 inches less than full height of fabric, minimum cross section of 3/16 inch by ¾ inch, and minimum of 1.2 ounces of zinc coating per square foot. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into post.

F. Tension and Brace Bands: 3/4 inch wide minimum hot-dip galvanized steel with minimum of 1.2 ounces of zinc coating per square foot.

1. Tension Bands: 0.74 inch thick (14 gage) minimum
2. Brace Bands: 0.1056 inch thick (12 gage) minimum

G. Tension Wire: 0.177-inch-diameter metallic-coated tension wire conforming to ASTM A 824 with finish to match fabric.
1. Coating Type II zinc in following class as determined by ASTM A 90: Class 2, with minimum coating weight of 1.20 ounce per square foot of uncoated wire surface.

2.4 CONCRETE

A. Concrete: Provide concrete consisting of Portland cement per ASTM C 150, aggregate per ASTM C 33, and potable water. Mix materials to obtain concrete with minimum 28-day compressive strength of 3000 psi. Use at least four sacks of cement per cu. Yd., 1-inch maximum size aggregate, 3-inch maximum slump.

2.5 GATES

A. Fabricate perimeter frames of gates from same material and finish as fence framework. Assemble gate frames by welding. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members maximum of 8 feet apart unless otherwise indicated.

1. Fabric: Same as for fence unless otherwise indicated. Secure fabric at vertical edges with tension bars and bands and to top and bottom of frame with tie wires.
2. Bracing: Install diagonal cross-bracing consisting of 5/16-inch-diameter adjustable-length truss rods on gates to ensure frame rigidity without sag or twist.
3. Barbed Wire: Extend end members of gate frames 12 inches above top member and prepare to receive three strands of wire. Provide necessary clips for securing wire to extension.

B. Industrial Horizontal – Slide Gates

1. General: Comply with ASTM F 1184 for single slide gate types.

a. Classification: Type II Cantilever Slide, Class I with external roller assemblies.
b. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1184 for materials and protective coatings.

2. Frames and Bracing: Fabricate members from round galvanized steel tubing with outside dimension and weight according to ASTM F 1184 and the following:

a. Gate Fabric Height: 6 feet (1.83 m)
b. Gate Opening Width: As indicated on drawings.
c. Frame Members: Tubular Steel: 1.90 inches (48 mm) round or greater as required structurally..
d. Bracing Members: Tubular Steel: 1.90 inches (48 mm) round or greater as required structurally.

3. Frame Corner Construction:

   a. Welded frame with 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider.

4. Roller Guards: As required per ASTM F 1184 for Type II, Class 1 gates.

5. Hardware: Latches permitting operation from both sides of gate, and stops fabricated from galvanized steel. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate. Provide female receiver(s) to secure gate in closed position.

C. Swing Gates: Comply with ASTM F 900.

1. Steel: Single-swing Gates up to 10 feet wide:

   a. Up to and including 6 feet high: Fabricate perimeter frames of 1.900-inch minimum OD Type I and II steel pipe or 2-inch-square galvanized-steel tubing weighting 2.52 pounds per foot.

2. Gate Hardware: Provide galvanized hardware and accessories for each gate according to following:

   a. Keeper: Provide keeper for vehicle gates that automatically engages gate leaf and holds it in open position until manually released.

2.6 GATE OPERATOR

A. See Section 02831.

B. Coordinate and provide necessary fencing and gate accessories, fittings, components for a complete finished installation of gates and operators. Provide mounting hardware and location for accessories including intercoms and keypads as shown in the drawings.

2.7 PRIVACY SLATS

A. Material: Polyethylene tubular slats, not less than 0.023 inch (0.58 mm) thick, manufactured for chain-link fences from virgin polyethylene containing UV inhibitor, sized to fit mesh specified for vertical installation with vandal-resistant fasteners and top lock strips.

B. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install fence to comply with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted.

B. Excavation: Drill holes for posts to diameters and spacings indicated.

1. Unless otherwise indicated, excavate hole depths approximately 3 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface or greater if required to exceed frostline.

C. Setting Posts: Center and align posts in holes 3 inches above bottom of excavation. Space maximum of 10 feet on center, unless otherwise indicated.

1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
   a. Unless otherwise indicated, extend concrete footings 2 inches above grade and trowel to crown to shed water.

D. Bottom Rails: Run rail continuously to line posts, bending to radius for curved runs and at other posts terminating into rail end attached to posts. Provide expansion couplings as recommended by fencing manufacturer. Bottom rail must be not more than 3” and not less than 1” above the soil. Localized grading by the contractor will be required to accomplish this.

E. (Not Used) Center Rails:

F. Brace Assemblies: Install braces at gate posts and at both sides of corner and pull posts. Locate horizontal braces at mid-height of fabric on gate (which has top rail) and at ¾ fabric height on both sides of corners. Install so posts are plumb when diagonal rod is under proper tension.

G. Top Tension Wire: Install tension wire within 6 inches of top of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter (11-gage) hog rings of same material and finish as fabric wire, spaced maximum of 24 inches on center.

H. Fabric: Leave approximately 2 inches between finish grade and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on outside of security area, and anchor to framework so that fabric remains under tension after pulling force is released.

I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not over 15 inches on center.

J. Tie Wires: Use wire or proper length to secure fabric firmly to posts and rails. Bend ends of wire to minimize hazard to persons or clothing.

1. Maximum Spacing: Tie fabric to line posts 12 inches on center and to rails and braces 24 inches on center.

K. Fasteners: Install nuts for tension bands and carriage bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts for added security.

3.2 GATE INSTALLATION

A. Install all gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary. Install gates according to manufacturer’s instructions, plumb, level, and secure.

3.3 GATE OPERATOR INSTALLATION

A. See Section 02831.

3.4 ADJUSTING

A. Gates and Gate Operators: After repeated operation of completed installation equivalent to 3 days' use by normal traffic, readjust gates and gate operators and controls for optimum operating condition and safety. Lubricate operating equipment and clean exposed surfaces. Return in six months for repeat adjustments.

3.5 DEMONSTRATION

A. Instruct Owner's personnel on proper operation and maintenance of gate operators.

END OF SECTION 02822

SECTION 02831 – VERTICAL LIFT GATES

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. Gates: Motor operated, vertical sliding, with solar panel to battery power.

B. Related Sections include the following:

1. Division 2 Section “Chain Link Fences and Gates.”
2. Division 2 Section "Earthwork" for site excavation, fill, and backfill where chain-link fences and gates are located.
3. Division 3 Section "Cast-in-Place Concrete" for concrete equipment bases/pads for gate operators, drives, and controls, post concrete fill.
4. Division 16 Sections for electrical service and connections for motor operators, controls, limit and disconnect switches, and safety features and for system disconnect switches.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide chain-link fences and gates capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Minimum Post Size and Maximum Spacing for Wind Velocity Pressure: Determine based on mesh size and pattern specified, and on the following minimum design wind pressures and according to CLFMI WLG 2445:
   a. Wind Speed: 100 mph.
   b. Fence Height: Per drawings.
   c. Wind Exposure Category: B.

B. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.
   1. Gates and hardware.
   2. Gate operators, including operating instructions.
   3. Accessories.
   4. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Show locations of adjacent fences, gates, posts, rails, tension wires, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.

2. Wiring Diagrams: Power and control wiring and communication and access-control features.
3. 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.

C. Samples: Manufacturer's color charts or 6-inch lengths of actual units showing the full range of colors available for components with factory-applied color finishes.

D. Product Certificates: For each type of operator, and gate, signed by product manufacturer.
1. Strength test results for framing according to ASTM F 1043.

E. Qualification Data: For Installer.

F. Field quality-control test reports.

G. Warranty: Manufacturer’s standard limited 1 year warranty.

H. Maintenance Data: For the following to include in maintenance manuals:
1. Polymer finishes.
2. Gate operator.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
1. Engineering Responsibility: Preparation of data for gates, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Testing Agency Qualifications: 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 according to NETA ETT, or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

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. UL Standard: Provide gate operators that comply with UL 325.

E. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for gates shown on Drawings in relation to property survey and existing structures and proposed fencing. Verify dimensions by field measurements.

B. Interruption of Existing Utility Service: Do not interrupt utility services to 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 Architect no fewer than seven (7) days in advance of proposed interruption of utility services.
   2. Do not proceed with interruption of utility services without Architect's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Gates and operator:
      a. Basis of Design: Sun Power Security Gates Inc. Model C-50; www.sun-power.com

   2. Additional acceptable manufacturers:
      a. Ideal Manufacturing, Inc; 1-800-523-3888; www.idealmfginc.com
      b. Rising Star Industries; 1-800-704-2837; www.rsigate.com
      c. Or equal if approved in advance of bidding by the Architect.

2.2 VERTICAL OPENING GATES

A. General: Comply with ASTM F 1184 for gate.
   1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1184 for materials and protective coatings.

B. Frames and Bracing: Fabricate members from galvanized steel tubing with outside dimension and weight according to ASTM F 1184 and the following:
   1. Gate Fabric Height: Per drawings.
   2. Gate Opening Width: Per drawings.
   3. Pivot Post: 4x2x250 rectangular tubing with 1-1/2 cold roll round shaft.
   4. Cover: 20 ga. Galv. Coated sheet metal.
   5. Yoke: To receive the gate when in the down position.
   6. Frame Members:
      a. Tubular galvanized steel 2 inches square.

2.3 GATE OPERATORS

A. General: Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.
   1. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
   2. Provide operator with UL approval or -approved components.
   3. Provide electronic components with built-in troubleshooting diagnostic feature.

B. Comply with NFPA 70.

C. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG-1 and the following:
   1. Voltage: 12 V dc 60 month battery.
   2. Solar Panel: A photovoltaic cell that will keep the battery charged.
   3. Horsepower: 1/7.
   4. Ball bearing instant reverse.
   5. Safety Timer: Will shut off if gate malfunctions
   6. Time Delay: Relay that may be set to close the gate automatically at a given time after opening.
   7. Enclosure: Manufacturer's standard.
   8. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 5000 feet above sea level.
   9. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.

D. Gate Operator: Mounted as recommended by Manufacturer and as follows:
   1. Vertical Lift Gate Operators:
      a. Duty: Heavy duty, commercial/industrial.
      b. Gate Speed: 5 to 7 seconds to.
      c. Gate Weight: Maximum 300 lb.
      d. Gate Length: Maximum 20 feet; or as indicated, whichever less.
      e. Gate Height: Maximum 7 feet; or as indicated; whichever is less.
      f. Frequency of Use: 1800 cycles on charged battery.
      g. Operating Type: Vertical lift.
      h. Emergency disconnect: Manual release for finger touch opening, with 3-2ay electrical switch

E. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with enclosure for mounting, and with space for additional optional equipment. Provide the following remote-control device(s):
   1. Card Reader: Functions only when authorized card is presented. Programmable, magnetic single-code system; face-lighted unit fully visible at night.
      a. Reader Type: Manufacturer’s standard. First option in first subparagraph below prevents card from being used a second time for a set period of time or until after card is used to exit. Second option limits time allowed for use of card.
   2. Digital Access Control: Key pad that may be programmed to accept only a certain code or number of codes and that will activate the gate with this combination.
   3. Radio Control: Digital system consisting of code-compatible universal receiver for each gate, located where indicated, with remote antenna with coaxial cable and mounting brackets designed to operate gates. Provide 6 of programmable transmitter(s) with multiple-code capability permitting validating or voiding of not less than 1000 codes per channel configured for the following functions:
      a. Transmitters: Single-button operated, with open and close function.
   4. Vehicle Loop Detector: System including automatic closing timer with adjustable time delay before closing, and loop detector designed to open and close gate. Provide electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location shown on Drawings, as recommended in writing by detection system manufacturer for function indicated.
      a. Loop: Wire, in size indicated for field assembly, for pave-over or saw-cut with epoxy-grouted installation; or:
      b. Loop: Factory preformed in size indicated; style for pave-over or saw-cut with epoxy-grouted installation.

5. Vehicle Presence Detector: System including automatic closing timer with adjustable time delay before closing, timer cut-off switch, and presence detector designed to hold gate open until traffic clears or reverse gate. Provide retroreflective or emitter/receiver detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of a vehicle in gate pathway when infrared beam in zone pattern is interrupted, and to emit a signal activating the gate operator.

F. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
   1. Action: Stop gate in opening cycle and reverse gate in closing cycle and hold until clear of obstruction.
   2. Options:
      a. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.
      b. Sensor Edge: Contact-pressure-sensitive safety edge, profile, and sensitivity designed for type of gate and component indicated, in locations as follows. Connect to control circuit. Retain first subparagraph below for swing gates. For slide gates, retain first two subparagraphs.
   3. Across entire gate leaf bottom edge.
   4. Photoelectric/Infrared Sensor System: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.

G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.

H. Emergency Release Mechanism: Quick-disconnect release of operator drive system of the following type of mechanism, permitting manual operation if operator fails. Design system so control circuit power is disconnected during manual operation.
   1. Type: Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge; or:
   2. Type: Mechanical device, key, or crank-activated release.

I. Accessories:
   1. External electric-powered [solenoid] [magnetic] lock with delay timer allowing time for lock to release before gate operates.
   2. Emergency Key (Knox) box.
   3. Goose neck post: Curved post to contain controls convenient to operate from Owner’s vehicles.

2.4 POLYMER FINISHES

A. Supplemental Color Coating: In addition to specified metallic coatings for steel, provide components with polymer coating.

B. Metallic-Coated Steel Framing and Fittings: Comply with ASTM F 626 and ASTM F 1043 for polymer coating applied to exterior surfaces and, except inside cap shapes, to exposed interior surfaces.
   1. Polymer Coating: Not less than 10-mil- thick PVC or 3-mil thick polyester finish.

C. Color: Match chain-link fabric complying with ASTM F 934.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance.
   1. Do not begin installation before final grading and paving is completed, unless otherwise permitted by Architect.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.3 GATE OPERATOR INSTALLATION

A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.

B. Excavation for Support Posts, Pedestals and Concrete Bases/Pads: Hand-excavate holes for bases/pads, in firm, undisturbed soil to dimensions and depths and at locations as required by gate-operator component manufacturer's written instructions and as indicated.

C. Concrete Bases/Pads: Cast-in-place depth not less than 12 inches below frost line or detail on Drawings, dimensioned and reinforced according to gate-operator component manufacturer's written instructions and as indicated on Drawings.

D. Vehicle Loop Detector System: [Cut grooves in pavement and] bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.

E. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.4 GROUNDING AND BONDING

A. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

B. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
   4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections having dissimilar metals with inert material to prevent futurepenetration of moisture to contact surfaces.

C. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.5 FIELD QUALITY CONTROL

A. Grounding-Resistance Testing: Engage a qualified independent testing and inspecting agency to perform field quality-control testing.
   1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
   2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
   3. Report: Prepare test reports certified by a testing agency of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.6 ADJUSTING

A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Automatic Gate Operator: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, alarms, and limit switches.
   1. Hydraulic Operator: Purge operating system, adjust pressure and fluid levels, and check for leaks.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lubricate hardware, gate operator, and other moving parts.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates. Refer to Division 1 Section "Project Closeout."

END OF SECTION 02831

SECTION 03052 – CONCRETE WATERPROOFING SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. SECTION INCLUDES:

1. This section specifies an integral concrete waterproofing system that can be used as a contractor's option entirely in lieu of the 03053 CONCRETE WATERPROOFING ADMIXTURE previously specified.

2. This section includes: Furnishing of all labor, materials, services and equipment necessary for the supply and installation of cementitious crystalline waterproofing mixed in concrete prior to placement as indicated on drawings and/or as specified.

3. This section includes crystalline waterproofing treatment of construction joints between successive concrete pours.

4. This section includes: Cleaning of concrete surface.

1.02 RELATED SECTIONS:

A. Section 03300 – Cast In Place Concrete
B. REPLACES - Section 03053 – Concrete Waterproofing Admixture
C. Section 03054 – Oliophobic Sealer
D. Section 07901 – Caulking and Sealants

1.03 SYSTEM DESCRIPTION

A. The complete systems include Cementitious Crystalline Waterproofing a blend of Portland cement, fine treated silica sand and active proprietary chemicals. When mixed with water and applied as an integral admixture**,** the active chemicals cause a catalytic reaction which generates a non-soluble crystalline formation of dendritic fibers within the pores and capillary tracts of concrete. This process causes concrete to become permanently sealed against the penetration of liquids from any direction in conjunction with the crystalline waterproofing treatment of construction joints between successive concrete pours. In addition, the completed system shall be warranted for five (5) years as a total and complete system. When appropriately cured the system shall be sealed using the product as described in Section 03054 – Oliophobic Sealer.

1.04 REFERENCES

A. ACI 305R - Hot Weather Concreting; 1999.

B. ACI 306R - Cold Weather Concreting; 1988.

C. ACI 308 - Standard Practice for Curing Concrete; 1992 (Re-approved 1997).

D. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 1999.

E. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 1998a.

F. ASTM C 666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing; 1997.

G. ASTM E 329 - Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction; 1998a.

H. COE CRD-C 48 - Standard Test Method for Water Permeability of Concrete; 1992.

I. NSF 61 - Drinking Water System Components - Health Effects; 2000a.

1.05 SUBMITTALS

A. Submittals shall comply with the General Conditions and Division-1 Specification Sections. Submit the following:

1. Submit under provisions of Section 01300.

2. Product Data: Manufacturer's printed data sheet, for specified products.

3. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

   i. Testing Agency: Independent laboratory meeting the requirements of ASTM E329 and certified by the United States Bureau of Standards, Army Corp of Engineers, and American Concrete Institute.

4. Certificates: Product certificates notarized by manufacturer certifying that:

   i. Materials comply with specified performance characteristics and physical requirements.

   ii. Installer is qualified and approved by manufacturer.

5. Manufacturer's installation instructions.

1.06 QUALITY ASSURANCE

A. MANUFACTURER QUALIFICATIONS: Minimum 10 years experience manufacturing and having at least 10 finished installations of crystalline waterproofing of the type and approximate project scope or greater specified.

B. CONCRETE BATCH OPERATOR QUALIFICATIONS: Certified by Manufacturer for mixing and use of Crystalline Waterproofing Admixture Products.

C. PRE-INSTALLATION MEETING: Prior to installation, conduct a meeting with the General Contractor, owner's representative, Architect, concrete installer, installers of adjacent work and work penetrating concrete, and admixture waterproofing manufacturer's representative to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements; notify the Owner and Architect at least one week in advance of meeting.

D. APPLICATOR: Waterproofing applicator shall be experienced in the installation of cementitious crystalline waterproofing materials as demonstrated by at least 10 previous successful installations, and shall be approved by the manufacturer in writing.

E. TECHNICAL CONSULTATION: Provide minimum of 1 person who shall be present during execution of Work, who shall be thoroughly experienced in installation of specified

materials, and who shall direct Work performed under this section. The waterproofing manufacturer's representative shall provide technical consultation on waterproofing application.

F. INSTALLER CERTIFICATION: Upon completion of application of waterproofing, submit certification that specified materials were applied in accordance with approved manufacturer's recommended procedures.

1.07 DELIVERY, STORAGE AND HANDLING

A. DELIVERY: Deliver packaged waterproofing materials to project site in original undamaged containers, with manufacturer's name, labels, product identification and seals intact.

B. STORAGE: Store all material in a secure, dry and temperature controlled area on pallets maintaining temperatures as recommended by the manufacturer's until installed.

C. HANDLING: A sufficient quantity of all materials including but not limited to waterproofing and construction joint products shall be stored on site or be readily available prior to starting the work to insure that the work will be continuous from start to completion without delay due to material shortage or unavailability.

1.08 WARRANTY

A. MANUFACTURER'S WARRANTY: Manufacturer's Warranty: Provide manufacturer's standard warranty document executed by authorized company official; warranty period: minimum Ten (10) years, commencing on Date of Substantial Completion.

B. APPLICATOR'S WARRANTIES: Applicator shall warrant the waterproofing and construction joint system(s) against defects caused by faulty workmanship or materials for a period of Five (5) years from Date of Substantial Completion. The warranty will cover the surfaces treated and will bind the applicator to repair, at his expense, any and all leaks through the treated surfaces which are not due to structural weaknesses or other causes beyond applicator's control such as fire, earthquake, tornado and hurricane.

PART 2 - PRODUCTS

2.01 MANUFACTURERS/ MATERIALS

A. The following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's product, nor shall it be construed that a named manufacturer's standard product will comply with the requirements of this Section. Candidate manufacturers include, listed below.

1. ACCEPTABLE MANUFACTURERS:
   a) Xypex Chemical Corporation (Basis Of Design); 13731 Mayfield Place, Richmond, B.C., Canada V6V 2G9; Tel: 800-961-4477; www.xypex.com

   b) Sika Corporation, Construction; 201 Polito Avenue, Lyndhurst, NJ 07071; Tel: 201-933-8800; usa.sika.com

   c) BASF Corporation – Admixture Systems; 23700 Chagrin Boulevard, Cleveland, OH 44122; Tel: 662-420-9563; www.BASF.com

2. Approved equals will be considered in accordance with provisions set forth in section 1600 of the project specifications.

3. Obtain all waterproofing products from a single source.

2.02 PRODUCTS:

A. Waterproofing Admixture: Xypex Admix C-500, C-1000 or C-2000 (Basis Of Design); compound of Portland cement, fine treated silica sand and active chemicals; provide product and mix ratio of at least 2% Xypex with up to 15% fly ash that produce concrete that complies with specified requirements in Section 03300 and the following:

1. Chemically Resistant for pH Levels of 3 to 11 constant contact and pH Levels of 2 to 12 periodic contact per ASTM C267-77, ASTM C672-76.

2. Potable Water Approved per National Safety Foundation (ANSI/NSF) 61.

3. Freeze-Thaw and De-icing Chemical Resistance per ASTM C672-76.

4. Radiation Resistance per USANI N69-1967

5. Crack Sealing ability for re-sealing cracks up to .04 mm (1/64”) per ASTM C856-88.

6. Withstand 175 PSI water pressure penetration test per U.S. Army Corps of Engineers CRD-C-48-73.

7. Concrete Admixture shall not decrease the compressive strength of the concrete mix design (28 day compressive strength test), ASTM C 39/C 39M.

B. Waterproofing Admixture: BASF Masterlife 300D; Crystalline Capillary Waterproofing Admixture.; provide product and mix ratio of at least 2% Masterlife 300D that produces concrete that complies with specified requirements in Section 03300 and the following:

1. Chemically Resistant for pH Levels of 3 to 11 constant contact and pH Levels of 2 to 12 periodic contact per ASTM C267-77, ASTM C672-76.

2. Potable Water Approved per National Safety Foundation (ANSI/NSF) 61.

3. Freeze-Thaw and De-icing Chemical Resistance per ASTM C672-76.

4. Radiation Resistance per USANI N69-1967

5. Crack Sealing ability for re-sealing cracks up to .04 mm (1/64”) per ASTM C856-88.

6. Withstand 175 PSI water pressure penetration test per U.S. Army Corps of Engineers CRD-C-48-73.

7. Concrete Admixture shall not decrease the compressive strength of the concrete mix design (28 day compressive strength test), ASTM C 39/C 39M.

2.03 MIXES

A. GENERAL: Mix waterproofing material by volume with clean water which is free from salt

and deleterious materials. Mix waterproofing material in quantities that can be applied within 20 to 30 minutes from time of mixing. As mixture thickens, stir frequently, but do not add additional water. Do not mix bonding agents or admixtures with crystalline waterproofing materials.

PART 3 - EXECUTION

3.01 CONCRETE MIXING AND PLACING

A. Comply with requirements of Section 03300.

B. Add waterproofing admixture at time of batching and blend thoroughly, following manufacturer's instructions.

C. Hot weather comply with ACI 305R; Cold weather comply with ACI 306R.

D. Moist cure concrete in accordance with ACI 308; if moist curing is not possible, use Xypex Gamma Cure curing compound complying with ASTM C 309.

E. Consult Manufacturer for mixing instructions, set times and retardation applications.

3.02 CONSTRUCTION JOINTS

A. Comply with manufacturer's instructions, including product data, technical bulletins, catalog installation instructions, and product packaging labels.

B. Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions,

C. Mix materials in accordance with manufacturer's instructions.

D. Wet cold joint surface and saturate with clean water to enhance the crystalline formation process within concrete; remove excess surface water before application of slurry coat.

E. Apply slurry coat if needed uniformly with semi-stiff bristle brush or spray under conditions and application rate recommended by manufacturer.

F. Place subsequent pour while slurry coat is still green, but after reaching initial set.

3.03 FIELD QUALITY CONTROL

A. Do not cover admixture treated concrete with other construction until it has been observed by Manufacturer's field representative and Architect/Engineer.

B. After removal of forms, repair honeycombing, rock pockets, tie holes, faulty construction joints, cold joints, and cracks using waterproofing admixture Manufacturer's products and recommended procedures.

C. MANUFACTURER'S FIELD SERVICES: Provide Manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of concrete batching and product installation in accordance with Manufacturer's and Engineer’s instructions.

D. FLOOD TESTING:

1. Plug or dam drains and fill area with water to a depth of two inches (50 mm) or to within 0.5 inch (12.5 mm) of top of waterproofing treatment.
2. Let water stand for 24 hours.

3. If leaks are discovered, make repairs and repeat test until no leaks are observed.

3.04 CLEANING AND PROTECTION

A. Protect installed concrete from damage during construction.

B. Do not apply paint or other coatings for at least 21 days; before applying coatings neutralize waterproofed surface as recommended by waterproofing manufacturer.

C. CLEANING: Clean spillage and soiling from adjacent surfaces using appropriate cleaning agents and procedures.

D. PROTECTION: Take measures to protect completed treated concrete from damage after application.

END OF SECTION 03052

SECTION 03053 – CONCRETE WATERPROOFING ADMIXTURE

PART 1 - GENERAL

1.1 DESCRIPTION

A. SECTION INCLUDES:

1. This section specifies an integral concrete waterproofing system of the slab on grade, wall curbs, and stem walls of the facility. This system utilizes a concrete densifier and sealer in an admixture Floor Treatment: A combination of chemicals that produces complete hydration resulting in a denser cement paste that produces an impermeable concrete that is hard non-dusting and safe for portable water.

2. This section includes: Furnishing of all labor, materials, services and equipment necessary for the supply and installation of waterproofing placement as indicated on drawings and as specified. Related Work: Documents affecting work of this Section include, but are not necessarily limited to: General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.

3. This section includes: provision of concrete curing, hardening, and sealing and cleaning of concrete surface.

B. RELATED SECTIONS:

1. Section 03300 – Cast In Place Concrete
2. Section 03054 – Oliophobic Sealer
3. Section 03055 – Salt and Water Barrier
4. Section 07901 - Caulking and Sealants

1.2 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential.

1. All hydraulic powered equipment must be diapered to avoid staining of the concrete.
2. No trade will park vehicles on the inside slab. If necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.
3. No pipe cutting machine will be used on the inside floor slab.
4. Steel will not be placed on interior slab to avoid rust staining.

1.3 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 35 calendar days after the contractor has received the owner's notice to proceed, submit the following material:

1. Materials list of items proposed to be provided under this section.
2. Manufacturer's specifications, test data and other data required to prove

compliance with the specified requirements.

3. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.

1.4 PRODUCT HANDLING:

A. Protect the materials of this Section before and after installation. Protect the work and materials of all other trades.

B. In the event of damage, immediately make replacements and repairs to the approval of the Architect and at no additional cost to the owners.

C. Store materials in clean, dry area in accordance with manufacturer's instructions. Keep containers sealed until ready for use. Keep from freezing.

D. Safety – Use approved safety glasses, rubber gloves, coveralls and work boots. Protect animals, vegetation and food items. Refer to the Material Safety Data Sheet (MSDS) for details.

PART 2- PRODUCTS

2.1 CURING/HARDENING/SEALING AGENT:

A. Where concrete cure, hardener and sealer is called for on the Drawing or is specified herein, provide one of the products as follows:

1. "Anti-Hydro" or "Anti-Hydro R" Waterproof Concrete
Anti-Hydro International
45 River Road
Flemington, NJ
800-777-1773

Salt Lake City:
Bruce Hutchinson
(801) 518-3770

2. Or, pre-approved equal.

B. Chemical Resistance: The manufacturer shall provide a chemical resistance guide listing test results by independent laboratories.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS:

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 MIXING:

A. The mix shall consist of Type I/II portland cement, clean, well grated, fine and coarse aggregates designed for maximum strength and denseness with a minimum of 6,000 psi

compressive strength. Each cubic yard shall contain a minimum of 7.5 bags of Type I/II portland cement and 1-1/2 gallons of Concrete Waterproofing Admixture. The Concrete Waterproofing Admixture shall be added with the mixing water or the concrete while partially mixed and mixed for a minimum 1 minute per cubic yard.

3.3 INSTALLATION:

A. Placing Concrete: All concrete shall be properly vibrated or consolidated and wood spreaders must be removed as the concrete rises in the forms. Whenever possible, concrete shall be placed continuously until the placement is completed. Construction joints shall be keyed with a 2”x4” key. When placing is about to be resumed, the joint shall be thoroughly cleaned and treated with a slush coat composed of 1 part Concrete Waterproof Admixture, 3 parts water and sufficient Type I/II portland cement to form a thick, creamy mixture. Concrete shall be placed before the slush coat dries. Refer to A.C.I. 201 “Guide to Durable Concrete” for recommended concreting practices.

B. Wall Finishing: After the forms are removed, all ties or spreaders shall be cut back on both walls faces to a depth of approximately 1-1/2”. Any cracks or honey combed concrete shall be cut back to sound concrete. These areas shall be treated with Concrete Waterproofing Admixture slush coat, then filled with a mortar consisting of 1 part Type I/II portland cement and 2 parts sand, mixed with a solution of 1 part Concrete Waterproofing Admixture to 10 parts water.

C. No concrete shall be placed on wet or soggy ground without first laying and compacting a bed of broken stone or gravel of adequate thickness to prevent the mud from mixing with the concrete. A pump of sufficient capacity to keep water below the placement and for a least 24 hours thereafter. The excavated area must be so prepared that the water will easily drain to the pump without washing cement out of the newly placed concrete.

D. If saw cutting is required, as soon as it is completed, the curing compound applied, and the area is clean and dry, apply masking tape over all saw cuts to keep dirt and debris out. Wait 28 days for sufficient vapor reduction and fill all saw cuts with approved crack filler.

E. For greater slump than 4”, add Concrete Waterproofing Admixture or approved equal in lieu of additional water.

F. Water Pressure: In dealing with any structure subject to hydrostatic pressure, careful consideration must be given to the design of the members. Thickness and reinforcing must be capable of withstanding maximum potential heads. Possibly flotation should be checked.

G. Placing and Curing Under Adverse Conditions: If concrete slabs are to be placed at temperatures over 80 degrees F, in the direct rays of the sun, or exposed to drying winds, care should be taken to prevent water loss and premature setting of the concrete. “Anti-Hydro R” should be used to maintain a normal concrete set time. Additionally, dampen sub-base, erect wind barriers, finish concrete promptly, and start curing immediately by the use of curing compound, water curing, or sheet materials. Continue curing for a minimum of 14 days.

4.1 WARRANTY:

Upon Completion of the work, as a condition of its acceptance, furnish the owner a written 5 year warranty signed by an officer of the manufacturer.

END OF SECTION

SECTION 03054 – OLIOPHOBIC SEALER

PART 1 - GENERAL

1.1 DESCRIPTION

A. SECTION INCLUDES:

1. This section specifies a topical concrete waterproofing system of the slab on grade, wall curbs, equipment pads of the Maintenance Building and the interior surfaces of the waste oil containment basin. This system utilizes a clear, breathable, high performance silane concrete sealer with an oliophobic additive for protecting new concrete surfaces. This low VOC compliant treatment forms an effective chloride screen that reduces surface erosion and corrosion of rebar and seals out water, chloride ions, and acids thereby reducing staining caused by motor oils and grease.

2. This section includes: Furnishing of all labor, materials, services and equipment necessary for the supply and installation of waterproofing placement as indicated on drawings and as specified. Related Work: Documents affecting work of this Section include, but are not necessarily limited to: General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.

3. This section includes: provision of concrete curing, hardening, and sealing and cleaning of concrete surface.

B. RELATED SECTIONS:

1. Section 03300 – Cast In Place Concrete
2. Section 03053 – Concrete Waterproofing Admixture
3. Section 07901 - Caulking and Sealants

1.2 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential.

1. All hydraulic powered equipment must be diapered to avoid staining of the concrete.
2. No trade will park vehicles on the inside slab. If necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.
3. No pipe cutting machine will be used on the inside floor slab.
4. Steel will not be placed on interior slab to avoid rust staining.

1.3 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 35 calendar days after the contractor has received the owner's notice to proceed, submit the following material:

1. Materials list of items proposed to be provided under this section.

2. Manufacturer's specifications, test data and other data required to prove compliance with the specified requirements.
3. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.

1.4 PRODUCT HANDLING:

A. Protect the materials of this Section before and after installation. Protect the work and materials of all other trades.

A. In the event of damage, immediately make replacements and repairs to the approval of the Architect and at no additional cost to the owners.

C. Store materials in clean, dry area in accordance with manufacturer's instructions. Keep containers sealed until ready for use. Keep from freezing.

PART 2- PRODUCTS

2.1 HARDENING/SEALING AGENT:

A. Where concrete hardener and sealer is called for on the Drawing or is specified herein, provide one of the products as follows:

1. Hydrozo 100 Plus
Degussa Building Systems
889 Valley Park Drive
Shakopee, MN 55379
(800) 433-9517

2. Stand Off SLX 100
Prosoco, Inc.
3741 Greenway Circle,
Lawrence, KS 66046
(800) 255-4255
FX (785) 830-9797

B. Or, pre-approved equal.

C. Chemical Resistance: The manufacturer shall provide a chemical resistance guide listing test results by independent laboratories.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS:

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION:

A. Prepare the surface in strict accordance with the manufacturers recommendations as approved by the architect.

B. Cure concrete in accordance with manufacturer's instructions and as specified in Section 03300.

3.3 APPLICATION:

A. Test a small area of the surface at least 4' by 4' square on a representative area of concrete slab and stem wall. Allow 5 – 7 days for the product to fully react before evaluating for the desired results and coverage rates. Keep test area available for evaluation throughout the sealing project.

B. Application should be made once the concrete has achieved 3000 psi strength.

C. Clean all surfaces of all sand, surface dust, and dirt, oil, grease, chemical films or coatings, and other contaminants prior to application. Use waterblast, sandblast, or shotblast as necessary to achieve a clean surface condition.

D. Crack control, caulking, patching, and expansion joint sealants should be installed prior to application of the sealer. Paint any line stripping prior to the application of product. Allow adequate curing time following sealant manufacturer's recommendations.

E. Application shall be made according to manufacturer's recommendations. Apply in a single, saturating application. Brush and/or broom drips and heavy runs thoroughly into the surface. All concrete surfaces shall be kept wet as required for complete coverage and penetration of product.

F. Achieve waterproofing without changing the natural appearance of the material, except for a latent waxy sheen on smooth troweled surfaces.

G. Do not dilute sealer.

H. Do not apply sealer if air temperature is expected to be above 90 degrees F or below 40 degrees F at the time of or within 24 hours after application or when rain is expected within 4 hours of application. Avoid application on hot, windy days.

I. Apply at least two applications of sealer. Apply the second coat within a few minutes after the first coat has penetrated and appears dry. Determine if additional applications of concrete sealer are necessary by testing surfaces in accordance with manufacturer's instructions.

J. Protect surfaces from traffic until sealer has cured.

4.1 WARRANTY:

A. Upon Completion of the work, as a condition of its acceptance, furnish the owner a written warranty signed by an officer of the manufacturer.

END OF SECTION

SECTION 03055 - SALT AND WATER BARRIER FOR EXTERIOR CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing of all labor, materials, services and equipment necessary for the supply and application of Salt and Water barrier applied to exterior concrete slabs. Documents affecting work of this section include, but are not limited to General Conditions, Supplementary conditions and Sections of Division 1 of these specifications.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.

1.3 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 35 calendar days after the contractor has received the owner's notice to proceed, submit the following material:

1. Materials list of items proposed to be provided under this section.
2. Manufacturer's specifications, test data and other data required to prove compliance with the specified requirements.
3. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.

1.4 PRODUCT HANDLING:

A. Protect the materials of this Section before and after installation. Protect the work and materials of all other trades.

B. In the event of damage, immediately make replacements and repairs to the approval of the Architect and at no additional cost to the owners.

C. Store materials in clean, dry area in accordance with manufacturer's instructions. Keep containers sealed until ready for use. Keep from freezing.

D. Safety – Use approved safety glasses, rubber gloves, coveralls and work boots. Protect animals, vegetation and food items. Refer to the Material Safety Data Sheet (MSDS) for details.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Approved Products:

1. Basis of Design:. Consolideck SatlGuard manufactured by PROSOCO, Inc., 3741 Greenway Circle, Lawrence, KS 66046. Phone: (800) 255-4255; Fax: (785) 830-

9797. E-Mail: Customercare@prosoco.com.

2. Professional Water Sealant manufactured by PROFESSIONAL PRODUCTS OF KANSAS, Inc., 4456 South Clifton, Wichita KS 67216. Phone (800) 676-7346; Fax (316) 522-9346, E-mail: ppk@watersealant.com

3. CP-500W manufactured by Chemical Products Industries Inc., 7649 SW 34th Street, Oklahoma City, OK. 73179. Phone (800) 624-4356; Fax (405) 745-2276. Web Site: www.chemicalproductsokc.com

4. Or pre-approved equal.

5. Substitutions: See Section 01631 – Product Substitutions

B. Product Description: A general-purpose silane / siloxane water repellent and chloride screen for concrete and masonry which protects horizontal and vertical surfaces from moisture intrusion and chemical attack of chloride salts, reducing rebar corrosion and surface spalling.

C. Technical Data: Provide a product which has the same technical data as follows:

1. FORM: Clear liquid
2. SPECIFIC GRAVITY: 0.794
3. ACTIVE CONTENT: 11%
4. WT./GAL.: 6.61 lbs.
5. FLASH POINT: 127 degrees F (53 degrees C) ASTM D 3278
6. FREEZE POINT: N/D
7. VOC CONTENT: Manufactured and marketed in compliance with USEPA AIM VOC regulations (40 CFR 59.403). Not suitable for sale in states and districts with more restrictive AIM VOC regulations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which waterproofing will be applied, with Installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.

1. Do not proceed with installation until after the minimum concrete curing period recommended by waterproofing manufacturer.

2. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by the plastic sheet method according to ASTM D 4263.

3. Notify Architect in writing of anticipated problems using waterproofing over substrate.

3.2 PREPARATION

A. Clean and prepare substrate according to manufacturer's recommendations. Provide clean, dust-free, and dry substrate for product application.

B. Mask off adjoining surfaces not receiving product application to prevent spillage affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of fluids.

D. Remove grease, oil, form release agents, paints, and other penetrating contaminants from concrete. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

Comment [COMMENT1]: RETAIN BELOW FOR DECKS WHEN A CONTROLLED SUBSTRATE SURFACE FINISH IS NEEDED FOR WATERPROOFING ADHESION.

3.3 APPLICATION

A. Before applying, read “Preparation” and “Safety Information” sections in the Manufacturer’s Product Data Sheet for the product. Refer to the Product Data Sheet for additional information about application of the product. Do not dilute or alter.

B. Horizontal Application: Apply protective treatment in a single saturating application. Use enough to keep the surface wet for a few minutes before penetrating. Broom out all puddles thoroughly until they penetrate the surface.

C. Comply with all manufacturer’s requirements and application instructions.

END OF SECTION 03055

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Work Specified Elsewhere:
1. 03052 Concrete Waterproofing Admixture.
2. 03053 Concrete Waterproofing Admixture
3. 03054 Oliophobic Topical Concrete Sealer

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

B. Cast-in-place concrete includes but is not limited to the following:

1. Foundations and footings.
2. Slabs-on-grade.
3. Stem walls.
4. Equipment pads and bases.
5. Suspended slabs.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, curing compounds, and others if requested by Architect.

1. Letter from concrete supplier, certifying type of cement to be used in concrete mix.

C. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.

D. Formwork Shop drawings: For foundation and retaining walls, submit formwork shop drawings prepared by or under the supervision of a qualified professional engineer detailin fabrication, assembly, and support of formwork.

E. Samples of materials as requested by Architect, including names, sources, and descriptions, as follows:

1. Waterstops

F. Laboratory test reports for concrete materials and mix design test.

G. Material certificates in lieu of material laboratory test reports when permitted by Architect.

Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. International Building Code, Chapter 19.
2. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
3. ACI 318, "Building Code Requirements for Reinforced Concrete."
4. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."

B. Concrete Testing Service: Provide a qualified testing agency , acceptable to Architect, to provide pre-construction testing and material evaluation tests.

C. Materials and installed work may require testing and retesting at any time during progress of Work. Retesting of rejected materials for installed Work, shall be done at Contractor's expense.

D. Special Inspection: Owner will provide special inspection services for concrete work as required by Contract Documents.

1. General: Contractor to coordinate work with the special inspection requirements of this section, the latest edition in practice of the International Building Code, Chapter 17, and specific requirements of the Owner.

1.5 WARRANTY

A. Provide two year written guarantee to the End User, in form approved by the Architect to promptly remove and/or repair defective concrete (cracking, spalling, pitting or honeycombing) as directed by Architect and at Contractor's expense. New replacement work shall carry a similar new two year written guarantee. Guarantee shall start from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint and exposed form tie system shown on drawings.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 mg/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.

1. Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.

E. Chamfer exterior corners and edges of permanently exposed concrete 3/4” by 3/4”.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Epoxy-Coated Reinforcing Bars: ASTM A 615, Grade 60, deformed bars, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I/II.

1. Use one brand of cement throughout Project unless otherwise acceptable to Architect.

B. Fly Ash: Conform to ASTM C 618 Class C or F

C. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.

1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.

D. Water: Potable.

E. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
   a. Air-Mix or Perma-Air, Euclid Chemical Co.
   b. Darex AEA or Daravair, W.R. Grace & Co.
   c. MB-VR or Micro-Air, Master Builders, Inc.
   d. Sika AER, Sika Corp.

G. Water-Reducing Admixture: ASTM C 494, Type A.

H. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.

I. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.

2.4 RELATED MATERIALS

A. Sand Cushion: Clean, manufactured or natural sand.

B. Bonding Agent: Polyvinyl acetate or acrylic base.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
   a. Polyvinyl Acetate (Interior Only):
      1) Euco Weld, Euclid Chemical Co.
      2) Everweld, L&M Construction Chemicals, Inc.
      3) Ready Bond, Symons Corp.

   b. Acrylic or Styrene Butadiene:
      1) SBR Latex, Euclid Chemical Co.
      2) Daraweld C, W.R. Grace & Co.
      3) Everbond, L&M Construction Chemicals, Inc.
      4) Acryl-Set, Master Builders Inc.

C. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
      a. Euco Epoxy System #452 or #620, Euclid Chemical Co.
      b. Concresive Standard Liquid, Master Builders, Inc.
      c. Sikadur 32 Hi-Mod, Sika Corp.

D. Dress Coat: Second coat of water-based acrylic membrane curing compound, same product used for curing; see para. C. above.

2.5 PROPORTIONING AND DESIGNING MIXES

A. Prepare design mixes for each type and strength of concrete by laboratory trial batch. For the trial batch method, use an independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

   1. Do not use the same testing agency for field quality control testing.

B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Architect. Allow 14 days for review response.

C. Design mixes to provide normal weight concrete with the following properties as indicated on drawings and schedules:

   1. Footings, 28-day compressive strength (minimum 6 bag mix) as indicated on

drawings; water-cement ratio: 0.45 maximum.

2. Foundations, 28-day compressive strength (minimum 6 bag mix) as indicated on drawings; water-cement ratio: 0.45 maximum. Ready mix concrete supplier to modify the sand/aggregate ratio and/or use plasticizers to reduce the likelihood of honeycombing due to inadequate vibration during installation.
3. Slabs-on-grade and all other concrete: 28-day compressive strength as indicated on drawings; water-cement ratio: 0.45 maximum.
4. Concrete over Metal Deck, 28-day compressive strength (minimum 5.8 bag mix) as indicated on drawings; water-cement ratio: 0.45 maximum.
5. Fly Ash Conform to ASTM C 618 Class C or F
6. For air-entrainment requirements see paragraph 2.6.C.

D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as described below. Modification of slump limits shall not be made without prior approval from the Engineer.

1. Slabs: Not more than 4 inches.
2. Reinforced foundation systems: Not less than 2 inch and not more than 4 inches.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted and accepted by Architect before using in Work.

2.6 ADMIXTURES

A. Use water-reducing admixture in concrete, as required, for placement and workability.

B. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).

C. Use air-entraining admixture in exterior exposed concrete including foundation stem walls, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content of 6-1/2 percent plus or minus 1-1/2 percent.

D. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials, vapor barrier, and other related materials with placement of forms and reinforcing steel.

3.2 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:

1. Provide Class A tolerances for concrete surfaces exposed to view.
2. Provide Class C tolerances for other concrete surfaces.

B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.

C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.

D. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.

E. Chamfer all exposed corners and edges unless noted otherwise, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

F. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.3 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Architect.

D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position

during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

3.4 JOINTS

A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Architect.

B. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

C. Shrinkage (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown on drawings. Depth and width of saw cut per details on drawings.

1. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
2. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
3. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

3.5 INSTALLING EMBEDDED ITEMS

A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.6 PREPARING FORM SURFACES

A. General: Coat contact surfaces of forms with an approved, non-residual, low-VOC, form-coating compound before placing reinforcement.

B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

1. Coat steel forms with a non-staining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.7 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.

1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
3. Maintain reinforcing in proper position on chairs during concrete placement.

F. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

G. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified. Concrete should not be placed when temperature is above 95□F unless approved by the Architect.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect.

I. Notify Architect/Engineer minimum 24 hours prior to commencement of operations.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Smooth-Formed Finish: Provide a smooth-formed architectural finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas per Section 3.15 with fins and other projections completely removed and smoothed and voids repaired when forms are removed. Refer to drawings for tie pattern and placement.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.9 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, and other bonded applied cementitious finish flooring material, and where indicated.

1. After placing slabs, finish surface to tolerances of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

2. Do not apply curing compounds to surfaces which receive tile finishes or in any way interfere with concrete performance.

B. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.

1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system.

C. Non-slip Broom Finish: Apply a non-slip broom finish to exterior concrete platforms, steps,

and ramps, and elsewhere as indicated.

1. Immediately after float finishing, roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

3.11 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete slabs from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. Start initial slab curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Curing Methods: Wet cure all unformed concrete surfaces. Curing compound may be used only where its use will not adversely affect the application of hardners/sealers or finish floor covering, as approved by the Architect by submittal documenting compatibility prior to the application of the curing compound.

D. Provide moisture curing by the following methods:

1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

2. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:

   a. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
   b. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete. Fugitive dye required in all curing compounds.

E. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams,

supported slabs, and other similar surfaces by leaving forms in place for the full curing period. Forms may be removed, but continue curing by an approved moisture curing method.

3.12 REMOVING FORMS

A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after maintaining not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing operations are started and protection operations are maintained.

3.13 REUSING FORMS

A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Architect.

3.14 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms to satisfaction of Architect.

B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.

2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.

1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low

and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
3. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter and areas retaining more than 1/8" deep liquid to nearest designated joint, by cutting out and replacing with new concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

E. Repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

F. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.

G. Repair methods not specified above may be used, subject to acceptance of Architect.

3.15 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. General: Owner to provide a testing agency to perform material tests, special inspections and to submit test reports. Contractor to coordinate with testing agency for sequence of work and inform testing agency when work is ready for testing and inspections.

B. Sampling and testing for quality control during concrete placement to include the following:

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

   a. Slump: ASTM C 143; one test at point of discharge for each 20 cu. yd. of each type of concrete; additional tests when concrete consistency seems to have changed.
   b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each 20 cu. yd. of each type of air-entrained concrete.
   c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
   d. Compression Test Specimen: ASTM C 31; one set of three standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when

field-cured test specimens are required.

e. Compressive-Strength Tests: ASTM C 39; one set of three cylinders for each 20 cu. yd. of each concrete class placed in any one day; one specimen tested at 7 days, one specimen tested at 28 days, and one specimen retained in reserve for later testing if required.

C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

1. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

D. Test results will be reported in writing to Owner, Architect, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

F. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed (see 1.4.C).

END OF SECTION 03300

SECTION 03450 - ARCHITECTURAL PRECAST CONCRETE

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. Architectural precast concrete units.

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry Assemblies" for thin brick setting materials and installation after precast concrete panel production.
2. Division 7 Section "Water Repellents" for water-repellent finish treatments.

1.3 DEFINITION

A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:

a. Upward and downward movement of 1/2 inch (13 mm).

2. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

C. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.

Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.

D. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 inches.

1. Include Sample showing color and texture of joint treatment.

a. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.
b. Grout Samples for Verification: Showing color and texture of joint treatment.

E. Qualification Data: For fabricator.

F. Material Test Reports: For aggregates.

G. Material Certificates: For the following items, signed by manufacturers:

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.

H. Source quality-control test reports.

I. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Participates in PCI's plant certification program and is designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units or participates in APA's "Plant Certification Program for Production of Architectural Precast Concrete Products" and is designated an APA-certified plant.

B. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.

B. Support units during shipment on nonstaining shock-absorbing material.

C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

D. Place stored units so identification marks are clearly visible, and units can be inspected.

E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.

F. Lift and support units only at designated points shown on Shop Drawings.

1.8 SEQUENCING

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Fabricators: Subject to compliance with requirements.

2.2 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

2.3 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin Admixture: ASTM C 618, Class N.
3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.

a. Gradation: Uniformly graded.

D. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading. Color to be selected by Architect from a full range of colors including all custom colors.

E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017 M.

2.5 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

C. Carbon-Steel Plate: ASTM A 283/A 283M.

D. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.

E. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.

2.6 ACCESSORIES

A. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.7 GROUT MATERIALS

A. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

1. Limit use of fly ash and silica fume to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.

D. Normal-Weight Concrete Mixtures: Proportion full-depth mixture by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.
2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.9 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.

B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces exposed to view in the finished work.
2. Edge and Corner Treatment: Uniformly [chamfered] [radiused].

2.10 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcement to maintain at least 3/4-inch (19-mm) minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

C. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.

D. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.

2.11 FINISHES

A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample.

B. Finish exposed surfaces of architectural precast concrete units to match face-surface finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Do not install precast concrete units until supporting cast-in-place building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is complete.

3.2 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

C. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

3.3 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).

C. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.4 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03450

SECTION 05400 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Interior load-bearing wall framing.
   2. Exterior non-load-bearing wall framing.
   3. Floor joist framing.
   4. Roof trusses.
   5. Roof rafter framing.
   6. Ceiling joist framing.

B. Related Sections include the following:

   1. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
   2. Division 9 Section "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
   3. Division 9 Section "Gypsum Board Shaft-Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

   1. Design Loads: As indicated**.**

   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft..
      b. Floor Joist Framing: Vertical deflection of 1/480 for live loads and l/240 for total loads of the span.
      c. Ceiling Joist Framing: Vertical deflection of 1/240 of the span.

   3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F .
   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

a. Upward and downward movement of 1/2 inch.

B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Qualification Data: For professional engineer and testing agency.

E. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

1. Steel sheet.
2. Power-actuated anchors.
3. Mechanical fasteners.
4. Vertical deflection clips.
5. Horizontal drift deflection clips
6. Miscellaneous structural clips and accessories.

F. Research/Evaluation Reports: For cold-formed metal framing.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

D. Product Tests: Mill certificates or data from a qualified independent testing agency**,** or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility**,** and metallic-coating thickness.

E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

H. Comply with AISI's "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:

1. Allied Studco.
2. AllSteel Products, Inc.
3. California Expanded Metal Products Company.
4. Clark Steel Framing.
5. Consolidated Fabricators Corp.; Building Products Division.
6. Craco Metals Manufacturing, LLC.
7. Custom Stud, Inc.
8. Dale/Incor.

9. Design Shapes in Steel.
10. Dietrich Metal Framing; a Worthington Industries Company.
11. Formetal Co. Inc. (The).
12. Innovative Steel Systems.
13. MarinoWare; a division of Ware Industries.
14. Quail Run Building Materials, Inc.
15. SCAFCO Corporation.
16. Southeastern Stud & Components, Inc.
17. Steel Construction Systems.
18. Steeler, Inc.
19. Super Stud Building Products, Inc.
20. United Metal Products, Inc.

2.2 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G60 or equivalent.

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G90.

2.3 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated.
2. Flange Width: As indicated.
3. Section Properties: As indicated.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated.
2. Flange Width: As indicated.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: As indicated.
2. Section Properties: As indicated.

D. Steel Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
1. Minimum Base-Metal Thickness: As indicated.
2. Section Properties: As indicated.

2.4 FLOOR JOIST FRAMING

A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, punched**,** with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated.
2. Flange Width: As indicated..
3. Section Properties: As indicated.

B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel joists.
2. Flange Width: 1-5/8 inches, minimum.

2.5 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As required by design.
2. Flange Width: As required by design.
3. Section Properties: As required by design.

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel headless, hooked bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.9 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

   a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 7 Section "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: As indicated.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced 48 inches. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 3 inches.
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

C. Space joists not more than 2 inches from abutting walls, and as follows:

1. Joist Spacing: As indicated.

D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:

1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.6 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05400

SECTION 05500 - METAL FABRICATIONS

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 metal fabrications:

1. Rough hardware.

2. Loose bearing and leveling plates.

3. Shelf and relieving angles.

4. Miscellaneous framing and supports for the following:
   a. Overhead doors.
   b. Hoist track and bracing. (Provided under Section 14620)
   c. Applications where framing and supports are not specified in other sections.
   d. Miscellaneous steel trim, including the following:
      1) Edgings.
      2) Loading dock edge angles.
      3) Floor plate and supports.
      4) Pipe guards.
      5) Pipe bollards.

F. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 5 Section 05521 "Pipe and Tube Railings" for steel pipe and tube railing systems.

2. Division 5 Section 05510 “Metal Stairs” for metal framed stairs with metal pan, metal plate or grating treads and for pipe and railing systems.

3. Division 5 Section 05530 "Gratings" for metal gratings and frames.

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 prefabricated building columns, steel floor plate, paint products and grout.

C. Shop drawings detailing 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. Provide templates for anchors and bolts specified for installation under other Sections.

D. Samples representative of materials and finished products as may be requested by Architect.

E. Welder certificates signed by Contractor certifying that welders comply with requirements

specified under the "Quality Assurance" Article.

F. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of completed projects with project name, addresses, names of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing metal fabrications similar to those indicated for this Project with a record of successful in-service performance, and with sufficient production capacity to produce required units without delaying the Work.

B. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel," AWS D1.2 "Structural Welding Code--Aluminum," and AWS D1.3 "Structural Welding Code--Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5. PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabrication. Show recorded measurements on final 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 dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. Wide Flange Shapes: ASTM A992 (50ksi)

C. Other Shapes, Plates and Bars: ASTM A 36/A 36M.

D. Rolled Steel Floor Plates: ASTM A 786/A 786M.

E. Steel Tubing: Product type (manufacturing method) and as follows:

1. Cold-Formed Steel Tubing: ASTM A 500.
   a. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A 53.

F. Steel Pipe: ASTM A 53, standard weight (schedule 40), unless otherwise indicated, or another weight required by structural loads.

1. Galvanized finish for exterior installations and where indicated.

G. Gray-Iron Castings: ASTM A 48, Class 30.

H. Malleable-Iron Castings: ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

I. 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.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.

J. Welding Rods and Bare Electrodes: Select according to AWS specifications for the metal alloy to be welded.

2.2 ALUMINUM

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-T6.

B. Aluminum-Alloy Rolled Tread Plate: ASTM B 632 (ASTM B 632M) Pattern 1, alloy 6061-T6.

2.3 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements of FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

2.4 FASTENERS

A. General: Provide plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating, for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568, Property Class 4.6), with hex nuts, ASTM A 563 (ASTM A 563M), and, where indicated, flat washers.

C. Machine Screws: ANSI B18.6.3.

D. Lag Bolts: ANSI B18.2.1 (ANSI B18.2.3.8M).

E. Wood Screws: Flat head, carbon steel, ANSI B18.6.1.

F. Plain Washers: Round, carbon steel, ANSI B18.22.1 (ANSI B18.22M).

G. Lock Washers: Helical, spring type, carbon steel, ANSI B18.21.1.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Material: Carbon steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Group 1 alloy 304 or 316 stainless-steel bolts and nuts complying with ASTM F 593 (ASTM F 738M) and ASTM F 594 (ASTM F 836M).

I. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as required.

2.5 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.

B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

1. Nonshrink, Nonmetallic Grouts:
   a. B-6 Construction Grout; W. R. Bonsal Co.
   b. Euco N-S Grout; Euclid Chemical Co.
   c. Five Star Grout; Five Star Products.
   d. Crystex; L & M Construction Chemicals, Inc.
   e. Masterflow 928 and 713; Master Builders Technologies, Inc.

2.6 CONCRETE FILL

A. Concrete Materials and Properties: Comply with requirements of 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 (20 MPa), unless higher strengths are indicated.

2.7 FABRICATION, GENERAL

A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
   1. Temperature Change (Range): 100 deg F (55.5 deg C).

D. Shear and punch metals cleanly and accurately. Remove burrs.

E. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

F. Remove sharp or rough areas on exposed traffic surfaces.

G. 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 that no roughness shows after finishing, and contour of welded surface matches those adjacent.

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

I. 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.

J. 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.

K. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

L. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.8 ROUGH HARDWARE

A. Furnish bent, or otherwise custom-fabricated, bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 Sections.

B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts that bear on wood structural connections, and furnish steel washers elsewhere.

2.9 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of the required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

2.10 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports for applications indicated that are not a part of structural steel framework as required to complete the Work.

B. Fabricate units to sizes, shapes, and profiles indicated and required to receive other adjacent construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
   a. Except as otherwise indicated, space anchors 24 inches (600 mm) o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long.

C. Galvanize miscellaneous framing and supports at exterior and interior locations.

2.11 FLOOR PLATE

A. Fabricate raised-pattern floor plates from rolled-steel floor plat of thickness and in pattern indicated below:

1. Thickness: 1/2 inch.
2. Pattern: As selected from manufacturer's standard patterns.

2.12 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices wherever possible.

B. Provide cutouts, fittings, and anchorages as required to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c., unless otherwise indicated.

C. Galvanize miscellaneous steel trim at exterior and interior locations.

2.13 CHAIN – NOT USED IN THIS PROJECT.

A. Provide electric-welded, heat-treated alloy steel chain and hooks at sander racks.

1. Lead capacity: 1,500 pounds per chain.

B. Provide safety yellow powder coated barrier chain and hooks, zinc plated steel, for removable post and chain at salt storage building.

2.14 FINISHES, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designing finishes.

B. Finish metal fabrications after assembly.

2.15 STEEL AND IRON FINISHES

A. Galvanizing: For those items indicated for galvanizing, apply zinc coating by the hot-dip

process complying with the following requirements:

1. ASTM A 153 for galvanizing iron and steel hardware.
2. ASTM A 123 for galvanizing both fabricated and un-fabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch (0.76 mm) thick or thicker.

B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC-SP 6 "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3 "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA 1 "Paint Application Specification No. 1" for shop painting.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous 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 as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication 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 the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended 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

that no roughness shows after finishing, and contour of welded surface matches those adjacent.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.3 SETTING LOOSE PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

B. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.

1. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 INSTALLING PIPE BOLLARDS

A. Anchor bollards in concrete as indicated on drawings.

B. Fill bollards solidly with concrete, mounding top surface.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a 2.0-mil (0.05-mm) minimum dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 Section "Painting."

C. For galvanized surfaces, clean welds, bolted connections, and abraded areas, and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 05500

SECTION 05510 - METAL STAIRS

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: Straight run, steel framed stairs.

B. Related Sections: The following Sections contain requirements that relate to this Section.

1. Division 5 “Metal Fabrications” for miscellaneous framing and metal items.

2. Division 5 Section "Pipe and Tube Railings" for pipe and tube handrails and railing systems, including those attached to metal stairs.

3. Division 5 Section "Gratings" for metal gratings and frames.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer, fabricate, and install steel stairs to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each component of steel stairs.

1. Treads of Steel Stairs: Capable of withstanding a uniform load of 100 lbf per sq. ft. (4.8 kN/sq. m) or a concentrated load of 300 lbf (1.35 kN) on a area of 4 sq. inches (26 sq. cm) located in the center of the tread, whichever produces the greater stress.

2. Platforms of Steel Stairs: Capable of withstanding a uniform load of 100 lbf per sq. ft. (4.8 kN/sq. m).

3. Stair Framing: Capable of withstanding stresses resulting from loads specified above as well as stresses resulting from railing system loads.

1.4 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 metal stairs, gratings, prefilled metal pan stair treads, nonslip aggregates and nonslip aggregate surface finishes, cast nosings, extruded nosings, steel floor plate, paint products, and grout.

C. Shop drawings detailing fabrication and installation of steel stairs. Include plans, elevations, sections, and details of steel stairs and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.

1. For installed steel stairs indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for their preparation.

D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

E. Qualification data for firms and persons specified in the "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. Fabricator Qualifications: Firm experienced in producing steel stairs similar to those indicated for this Project with a record of successful in-service performance and with sufficient production capacity to produce required units without delaying the Work.

B. Installer Qualifications: Arrange for steel stair installation specified in this Section by the same firm that fabricated them.

C. Engineer Qualifications: A professional engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of metal stairs (including handrails and railing systems) similar to this Project in material, design, and extent and that have a record of successful in-service performance.

D. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Metal Surfaces, General: For surfaces exposed to view in the completed Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, roughness, or, for steel sheet, variations in flatness exceeding those permitted by referenced standards for stretcher leveled sheet.

B. Wide Flange Shapes: ASTM A992 (50ksi)

C. Other Shapes, Plates and Bars: ASTM A 36/A 36M.

D. Steel Pipe: ASTM A 53, standard weight (schedule 40), unless otherwise indicated, or another weight required by structural loads.

1. Galvanized finish for exterior installations and where indicated.

E. Rolled Steel Floor Plate: ASTM A 786/A 786M.

F. Steel Bars for Gratings: ASTM A 569/A 569M or ASTM A 36/A 36M.

G. Wire Rod for Grating Cross Bars: ASTM A 510 (ASTM A 510M).

H. Galvanized Steel Sheet: Quality as follows:

1. Structural Quality: ASTM A 446/A 446M; Grade A, G 90 (Z 275) coating, unless another grade is required for design loading.

I. Welding Rods and Bare Electrodes: Select according to AWS specifications for the metal alloy to be welded.

2.2 FASTENERS

A. General: Provide plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating, for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.

B. Bolts and Nuts: Regular hexagon head type, ASTM A 325, with hex nuts, ASTM A 563 (ASTM A 563M), and, where indicated, harden washers.

C. Machine Screws: ANSI B18.6.3 (ANSI B18.6.7M).

D. Lag Bolts: ANSI B18.2.1 (ANSI B18.2.3.8M).

E. Plain Washers: Round, carbon steel, ANSI B18.22.1 (ANSI B18.22M).

F. Lock Washers: Helical, spring type, carbon steel, ANSI B 18.21.1.

G. Expansion Anchors: Anchor bolt and sleeve assemblies of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Material: Carbon steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.3 PAINT

A. Shop Primer for Ferrous Metal: Fast curing, lead- and chromate free, universal modified alkyd primer complying with performance requirements of FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field applied topcoats despite prolonged exposure.

B. Galvanizing Repair Paint: High zinc dust content paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.

C. Bituminous Paint: Cold applied asphalt mastic complying with SSPC Paint 12, except containing no asbestos fibers.

2.4 GROUT

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

B. Available Products: Subject to compliance with requirements, non-shrink, nonmetallic grouts that may be incorporated in the Work include, but are not limited to, the following:

1. Euco N-S Grout; Euclid Chemical Co.

2. Five Star Grout; Five Star Products.
3. Crystex; L&M Construction Chemicals, Inc.
4. Masterflow 928 and 713; Master Builders Technologies, Inc.
5. Sealtight 588 Grout; W. R. Meadows, Inc.
6. Or, pre-approved equal.

2.5 FABRICATION, GENERAL

A. Form steel stairs from materials of size, thickness, and shapes indicated, but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

C. Shear and punch metals cleanly and accurately.

D. Remove sharp or rough areas on exposed surfaces.

E. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

F. 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 that no roughness shows after finishing, and welded surface matches contours of adjoining surfaces.

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

H. Shop Assembly: Preassemble in shop to greatest extent possible to minimize field splicing and assembly. Use connections that maintain structural value of joined pieces. Clearly mark units for field assembly and coordinated installation.

I. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

A. General: Construct stairs to conform to sizes and arrangements indicated. Join pieces together by welding, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, columns, handrails, railing systems, newels, balusters, struts, clips, brackets, bearing plates, or other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.

1. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM "Metal Stair Manual" for class of stair designated, except where more stringent requirements are indicated.
   a. Architectural class where indicated.

B. Stair Framing: Fabricate stringers of structural steel channels, plates, or a combination thereof, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to stringers; and bolt or weld newels and framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finish surfaces.

1. Where masonry walls support steel stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Floor Grating Treads and Platforms: Provide patterns, spacing, and bar sizes indicated; fabricate to comply with ANSI/NAAMM MBG 531 "Metal Bar Grating Manual."

1. Fabricate treads from welded steel grating with 1-1/4-by-3/16-inch (32-by-4.8-mm) bearing bars at 15/16 inch (24 mm) o.c. and cross bars at 4 inches (100 mm) o.c., NAAMM designation: W-15-4 (1-1/4 x 3/16) STEEL.

2. Surface: Serrated.

3. Finish: Galvanized.

D. Fabricate grating treads with steel plate nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

E. Fabricate grating platforms with nosing matching that on grating treads at all landings. Provide toe plates at open-sided edges of grating platform. Secure grating to platform frame with welds.

2.7 FINISHES

A. General: Finish metal stairs after assembly.

1. Comply with NAAMM "Metal Finishes Manual" for recommendations on application and designations of finishes.

B. Galvanizing: Hot dip galvanize items indicated to be galvanized to comply with applicable standard listed below:

1. ASTM A 153 for galvanizing iron and steel hardware.

2. ASTM A 123 for galvanizing both fabricated and un-fabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch (0.76 mm) thick and heavier.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, weld plates, and anchor bolts. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where

necessary for securing steel stairs to in-place construction; include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing steel stairs. Set units 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 the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted 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 that no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on steel stairs are specified in Division 9 Section "Painting."

B. For galvanized surfaces, clean welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 05510

SECTION 05521 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes steel pipe and tube handrails and railing systems.

B. Related Sections: Requirements relating to this Section are contained in the following Sections:

1. Division 5 Section "Metal Fabrications" for miscellaneous steel fabrications.

2. Division 5 Section ”Gratings” for metal gratings and frames.

1.3 DEFINITIONS

A. Definitions in ASTM E 985 for railing-related terms apply to this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General: In engineering handrail and railing systems to withstand structural loads indicated, determine allowable design working stresses of materials based on the following:

1. Cold-Formed Structural Steel: AISI "Specification for the Design of Cold-Formed Steel Structural Members."

B. Structural Performance of Handrails and Railing Systems: Engineer, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.

1. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:

a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
b. Uniform load of 50 lbf per linear foot (730 N/m) applied horizontally and concurrently with uniform load of 50 lbf per linear foot (1460 N/m) applied vertically downward.
c. Concentrated and uniform loads above need not be assumed to act concurrently.

2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
b. Uniform load of 50 lbf per linear foot (730 N/m) applied in any direction.
c. Concentrated and uniform loads above need not be assumed to act

concurrently.

3. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in the system including panels, intermediate rails, balusters, or other elements composing the infill area.

   a. Above load need not be assumed to act concurrently with loads on top rails of railing systems in determining stress on guard.

C. Thermal Movements: Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in engineering, fabricating, and installing handrails and railing systems to prevent buckling, opening of joints, overstressing of components and connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.

   1. Temperature Change (Range): 120 deg F (67 deg C) ambient 180 deg F (100 deg C) material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

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 mechanically connected handrails and railing systems, each kind of fitting, grout, anchoring cement, and paint products.

C. Shop drawings showing fabrication and installation of handrails and railing systems including plans, elevations, sections, details of components, and attachments to other units of Work.

   1. For installed handrails and railing systems indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for their preparation.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of completed projects with project names, addresses, names of architects and owners, and other information specified.

E. Product test reports from a qualified independent testing agency evidencing compliance of handrails and railing systems with requirements based on comprehensive testing of current products.

F. Test reports from an independent testing agency evidencing compliance of handrails and railing systems with ASTM E 985.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain handrails and railing systems of each type and material from a single manufacturer.

B. Engineer Qualifications: Professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated for handrails and railing systems similar to this Project in material, design, and

extent, and that have a record of successful in-service performance.

1.7 STORAGE

A. Store handrails and railing systems inside a well-ventilated area, away from uncured concrete and masonry and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.8 PROJECT CONDITIONS

A. Field Measurements: Where handrails and railing systems are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final 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 dimensions and proceed with fabricating handrails and railing systems without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

1.9 SEQUENCING AND SCHEDULING

A. Sequence and coordinate installation of wall handrails as follows:

1. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS

A. General: Provide metals free from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.

B. Steel: Provide steel in the form indicated, complying with the following requirements:

1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:

a. Galvanized finish for exterior installations and where indicated.

b. Type F, or Type S, Grade A, standard weight (schedule 40), unless otherwise indicated, or another weight, type, and grade required by structural loads.

2. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Brackets, Flanges, and Anchors: Cast or formed metal of the same material and finish as supported rails, unless otherwise indicated.

2.2 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring railings to other types of construction indicated and capable of withstanding design loadings.

1. For steel railings and fittings, use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

C. Cast-in-Place and Post-installed Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials, capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified, independent testing agency.

1. Cast-in-place anchors.
2. Expansion anchors.

2.3 PAINT

A. Shop Primer for Ferrous Metal and Galvanized Steel: Refer to Division 9 Section "Painting" for primers.

B. Galvanizing Repair Paint: High zinc dust content paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, complying with DOD-P-21035 or SSPC-Paint 20.

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

2.4 GROUT AND ANCHORING CEMENT

A. Non-shrink, Nonmetallic Grout: Premixed, factory packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

B. Available Products: Subject to compliance with requirements, non-shrink, nonmetallic grouts that may be incorporated in the Work include, but are not limited to, the following:

1. Euco N-S Grout; Euclid Chemical Co.
2. Five Star Grout; Five Star Products.
3. Crystex; L & M Construction Chemicals, Inc.
4. Masterflow 928 and 713; Master Builders Technologies, Inc.
5. Sealtight 588 Grout; W.R. Meadows, Inc.
6. Or, pre-approved equal.

2.5 FABRICATION

A. General: Fabricate handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of hollow members, post spacings, and anchorage, but not less than those required to support structural loads.

B. Assemble handrails and railing systems in the shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly

and coordinated installation.

C. Form changes in direction of members as follows:

1. By radius bends of radius indicated.
2. By bending.
3. By mitering at elbow bends.
4. By any method indicated above, applicable to change of direction involved.

D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

E. Welded Connections: Fabricate handrails and railing systems for connection of members by welding. For connections made during fabrication, 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 tee and cross intersections, cope ends of intersecting members to fit contour of pipe or tube to which end is joined, and weld all around.
5. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

F. Brackets, Flanges, Fittings, and Anchors: Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing system members to other construction.

G. Provide inserts and other anchorage devices to connect handrails and railing systems to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railing systems. Coordinate anchorage devices with supporting structure.

H. For railing posts set in concrete, provide preset sleeves of steel, not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (12 mm) greater than outside dimensions of post, and steel plate forming bottom closure.

I. For removable railing posts, fabricate slip-fit sockets from steel pipe whose inside diameter is sized for a close fit with posts and to limit deflection of post without lateral load, measured at top, to not more than 1/12 of post height. Provide socket covers designed and fabricated to resist accidental dislodgement.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

J. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

K. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing work.

L. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws,

and similar items.

M. Provide weepholes, or another means to evacuate entrapped water, in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources.

N. Fabricate joints that will be exposed to weather in a manner to exclude water.

O. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.

P. Toe Boards: Provide toe boards at railings around openings and at the edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

Q. Fillers: Provide steel sheet or plate fillers, of thickness and size indicated or required to support structural loads of handrails, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses to produce adequate bearing to prevent bracket rotation and overstressing substrate.

2.6 FINISHES, 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 a strippable, temporary protective covering prior to shipment.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and they are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of handrails and railing systems.

2.7 STEEL FINISHES

A. Galvanized Finish: Hot-dip galvanize items indicated to be galvanized to comply with applicable standard listed below:

1. ASTM A 153 for galvanizing iron and steel hardware.
2. ASTM A 123 for galvanizing iron and steel products made from rolled, pressed, and forged steel shapes, castings, plates, bars, and strips.

B. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. For galvanized handrails and railing systems, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

D. Preparation for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

E. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed railings:

1. Interiors (SSPC Zone 1A): SSPC-SP 7 "Brush-Off Blast Cleaning."

F. Apply shop primer to prepared surfaces of handrails and railing components, unless otherwise indicated. Comply with requirements of SSPC-PA 1 "Paint Application Specification No. 1" for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
   1. Refer to Division 9 Section "Painting" for primer specification for galvanized and un-galvanized surfaces.
   2. Stripe paint all edges, corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installing anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors, that are to be embedded in concrete as masonry construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections accurately together to form tight, hairline joints.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing handrails and railing systems. Set handrails and railing systems accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.

   1. Do not weld, cut, or abrade surfaces of handrails and railing components that have been coated or finished after fabrication and are intended for field connection by mechanical or other means without further cutting or fitting.
   2. Set posts plumb within a tolerance of 1/4 inch in 12 feet (2 mm in 1 m).
   3. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (2 mm in 1 m).

C. Field Welding: Comply with the following requirements:

   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and welded surface matches contours of adjoining surfaces.

D. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loadings.

E. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing handrails and railing systems and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact, or use fittings designed for this purpose.

3.4 ANCHORING POSTS

A. Anchor posts in concrete with pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, solidly fill annular space between post and sleeve with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.
   1. Nonshrink, nonmetallic grout.

B. Cover anchorage joint with a round steel flange attached to post as follows:
   1. Welded to post after placement of anchoring material.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
   1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

D. Install removable railing sections where indicated in slip-fit metal sockets cast into concrete. Accurately locate sockets to match post spacing.

3.5 ANCHORING RAIL ENDS

A. Anchor rail ends into concrete and masonry with round flanges connected to rail ends and anchored into wall construction with postinstalled anchors and bolts.

3.6 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets and end fittings. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets and wall return fittings to building construction as follows:
   1. Use type of bracket with predrilled hole for exposed bolt anchorage.
   2. For concrete and solid masonry anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
   3. For hollow masonry anchorage, use toggle bolts with square heads.

3.7 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9.

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

3.8 PROTECTION

A. Protect finishes of handrails and railing systems from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05521

SECTION 05530 - GRATINGS

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. Metal bar gratings.
2. Heavy-duty metal bar gratings.
3. Metal frames and supports for gratings.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 5 Section "Metal Stairs" for metal framed stairs with grating treads.
2. Division 5 Section "Pipe and Tube Railings" for metal pipe and tube handrails and railing systems.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer, fabricate, and install gratings to withstand the following structural loads without exceeding the allowable design working stress of the grating materials, anchors, and connections.

1. Heavy-Duty Metal Bar Gratings: H-20 loading.

1.4 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 formed metal plank grating, manufacturer's clips and anchorage devices for gratings, and paint products.

C. Shop drawings detailing fabrication and erection of gratings. Include plans, sections, and details of connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.

1. For installed gratings indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for their preparation.

D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.

E. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project name, addresses and names of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing gratings similar to that indicated for this Project with a record of successful in-service performance and with sufficient production capacity to produce required units without delaying the Work.

B. Engineer Qualifications: A professional engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of gratings similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.

C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel," and AWS D1.3 "Structural Welding Code--Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.6 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which gratings must fit by accurate field measurements before fabrication; show recorded measurements on final 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 dimensions and proceed with fabricating gratings without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Bars for Gratings: ASTM A 569/A 569M or ASTM A 36/A 36M.

C. Wire Rod for Grating Cross Bars: ASTM A 510 (ASTM A 510M).

D. Welding Rods and Bare Electrodes: Select according to AWS specifications for the metal alloy to be welded.

2.2 PAINT

D. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.

E. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

2.3 FASTENERS

A. General: Provide plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating, for exterior use or where built into exterior walls. Select

fasteners for the type, grade, and class required.

B. Expansion Anchors: Anchor bolt and sleeve assemblies of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Material: Carbon steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

2.4 FABRICATION

A. General: Form from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support.

1. Shear and punch metals cleanly and accurately.
2. Remove sharp or rough areas on exposed traffic surfaces.
3. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated.

B. Welding: Comply with AWS recommendations and 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.

C. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

D. 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.

2.5 METAL BAR GRATINGS

A. General: Produce metal bar gratings of description indicated per NAAMM marking system that comply with the following:

1. Metal Bar Grating Standard: "Standard Specifications for Metal Bar Grating and Metal Bar Grating Treads" published in ANSI/NAAMM MBG 531 "Metal Bar Grating Manual."
2. Heavy-Duty Metal Bar Grating Standard: "Guide Specifications for Heavy Duty Metal Bar Grating" published in ANSI/NAAMM MBG 532 "Heavy Duty Metal Bar Grating Manual."

B. Fabricate welded steel gratings to comply with requirements indicated below:

1. Grating Mark W-15-4: Welded grating with bearing bars 15/16 inch (24 mm) o.c. and cross bars 4 inches (100 mm) o.c.
2. Bearing Bar Size: 1-1/4 inches (32 mm) by 3/16 inch (5 mm).
3. Location: Wash rack platform.

C. Fabricate welded heavy-duty steel gratings to comply with requirements indicated below:
   1. Location: Trench drain and wash rack drain.
      a. Grating Mark W-22-2: Welded grating with bearing bars 1-3/8 inches (35 mm) o.c. and cross bars 2 inches (50 mm) o.c.
      b. Bearing Bar Size: 2-1/4 inches (47 mm) by 1/4 inch (6 mm).

D. Traffic Surface for Steel Bar Gratings: Plain.

E. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.7 oz. per sq. ft. (515 g/sq. m) of coated surface.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering metal bar gratings that may be incorporated in the Work include, but are not limited to, the following:

   1. IKG Borden.
   2. Ohio Gratings, Inc.
   3. Seidelhuber Metal Products, Inc.
   4. Or, pre-approved equal.

2.6 GRATING FRAMES AND SUPPORTS

A. General: Provide steel frames and supports, where indicated.

B. Fabricate units to sizes, shapes, and profiles indicated and required to receive gratings. Fabricate from structural steel shapes, plates, and steel bars of welded construction. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware, and similar items.

C. Equip units with integrally welded anchors for casting into concrete or building into masonry.

   1. Unless otherwise indicated, space anchors 24 inches (600 mm) o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long.

D. Galvanize frames at interior and exterior locations.

2.7 FINISHES

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. Finish gratings, frames, and supports after assembly.

C. Galvanizing: For those items indicated for galvanizing, apply zinc coating by the hot-dip process complying with ASTM A 123.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing to in-place construction. Include expansion anchors for concrete and masonry, through-bolts, and other connectors as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation. Set 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 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 the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended 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.

3.3 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of NAAMM grating standard referenced under Part 2 that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Secure removable units to supporting members with type and size of clips and fasteners indicated, or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Secure non-removable units to supporting members by welding where both materials are the same; otherwise, fasten by bolting as indicated above.

3.4 ADJUSTING AND CLEANING

A. For galvanized surfaces, clean welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 05530

SECTION 06105 - MISCELLANEOUS CARPENTRY

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. Rough carpentry work not specified elsewhere and generally intended for support of other work.
2. Sheathing.
3. Miscellaneous blocking, grounds, nailers, and panels.

B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 6 Section "Interior Architectural Woodwork" for interior casework elements specially fabricated for this Project.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

B. Wood treatment data from chemical treatment manufacturer. Include chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated material.

1. Preservative Treatment: Include certification by treatment plant stating type of solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
2. Waterborne Preservative Treatment: Include certification that moisture content of treated wood was reduced to levels specified prior to shipment to Project site.
3. Fire-Retardant Treatment: Include certification by treating plant that treated wood complies with specified requirements.
4. Warranty: Include warranty of chemical treatment manufacturer for each type of treatment.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack material above ground level on uniformly spaced supports to prevent deformation.
1. For material pressure treated with waterborne chemicals, place spacers between each bundle for air circulation.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Standards: Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and graded in accordance with the Western Lumber Grading Rules (WWPA).

B. Grade Stamps: Furnish lumber with each piece factory-marked with grade stamp of inspection agency that indicates grading agency, grade, species, moisture content at time of surfacing, and mill.

C. Sizes: Provide nominal sizes indicated, complying with PS 20 except where actual sizes are specifically noted as being required.

D. Surfacing: Dressed lumber, S4S, unless otherwise indicated.

E. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

2.2 DIMENSION LUMBER FOR CONCEALED CONDITIONS

A. Species: Douglas-fir.

B. Moisture Content: S-DRY, KD 19 or MC 19 (19 percent maximum moisture content).

C. Grade: No. 2 or better.

2.3 CONSTRUCTION PANELS

A. Standards: Comply with requirements of PS 1 Voluntary Product Standard "Construction and Industrial Plywood" for veneer plywood and APA PRP-108 "Performance Standards and Policies for Structural-Use Panels" for performance-rated panels.

1. Trademark: Furnish construction panels that are each factory-marked with APA trademark for grade specified.

C. Miscellaneous Exposed Interior Plywood Wall Panels: DOC PS 1, C-D Interior, thickness as indicated.

D. Electrical/Telephone Backing Panels: APA-RATED SHEATHING, Exposure 1, fire-retardant treated, thickness as indicated but not less than 15/32 inch.

2.4 FASTENERS

A. General: Provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.

B. Nails, Wire, Brads and Staples: FS FF-N-105.

C. Bolts: ASTM A 307, Grade A; with ASTM A 563 hex nuts and flat washers.

2.5 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

A. General: Obtain preservative-treated lumber complying with AWPA Standard C2. Mark each treated item with AWPB or SPIB Quality Mark Requirements. Coat surfaces cut after treatment to comply with AWPA M4.

B. Above-Ground Wood Treatment: Pressure treat with CCAC preservatives to a minimum retention of 0.25 pcf.

1. Kiln-dry interior dimension lumber after treatment to 19 percent maximum moisture

content.

2. Treat wood items indicated and in the following circumstances:
   a. In contact with roofing, flashing, or waterproofing.
   b. In contact with masonry or concrete.
   c. Within 18 inches of grade.

2.6 FIRE RETARDANT TREATMENT BY PRESSURE PROCESS

A. General: Identify treated wood with appropriate classification marking of Underwriters Laboratories Inc. or other testing and inspection agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of miscellaneous carpentry and in sizes that would require an excessive number or poor arrangement of joints.

B. Cut and fit miscellaneous carpentry accurately. Install members plumb and true to line and level.

C. Coat cut edges of preservative-treated wood to comply with AWPA M4.

D. Securely fasten miscellaneous carpentry as indicated and according to applicable codes and recognized standards.

E. Use fasteners of appropriate type and length. Pre-drill members when necessary to avoid splitting wood.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. Install where shown and where required for screeding or attachment of other work. Cut and shape to required size. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.

END OF SECTION 06105

SECTION 06173 – PLATE CONNECTED WOOD TRUSSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated wood trusses for roof framing.

B. Bridging, bracing, and anchorage.

1.02 RELATED REQUIREMENTS

A. Section 06105 - Rough Carpentry: Installation requirements for miscellaneous framing.

1.03 REFERENCE STANDARDS

A. RIS (GR) - Standard Specifications for Grades of California Redwood Lumber; Redwood Inspection Service; 2000.

B. TPI 1 - National Design Standard for Metal Plate Connected Wood Truss Construction; Truss Plate Institute; 2002 and errata (ANSI/TPI 1).

C. TPI DSB-89 - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses; Truss Plate Institute; 1989.

D. BCSI 1 - Building Component Safety Information Booklet: The Guide to Good Practice for Handling, Installing & Bracing of Metal Plate Connected Wood Trusses; joint publication of the Truss Plate Institute and the Wood Trust Council of America; 2006.

1.04 DESIGN REQUIREMENTS

A. Comply with applicable code for structural loading criteria and fire retardant requirements.

B. Design Roof Live and Dead Loads as indicated with deflection limited to 1/240.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on plate connectors, bearing plates, and metal bracing components.

C. Shop Drawings: Show truss configurations, sizes, spacing, size and type of plate connectors, cambers, framed openings, bearing and anchor details, and bridging and bracing.
   1. Provide shop drawings showing conformance to proposed layout, and profile of structural trusses and selected overbuild trusses as shown in PART 4 of this specification section
   2. Shop drawings shall be stamped or sealed by design engineer.

1.06 QUALITY ASSURANCE

A. Truss Design, Fabrication, and Installation: In accordance with TPI 1, TPI DSB-89, and BCSI 1.

B. Fabricator Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

C. Designer Qualifications: Perform design by or under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle and erect trusses in accordance with BCSI 1.

B. Store trusses in vertical position resting on bearing ends.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Truss Plate Connectors:
   1. Alpine Engineered Products, Inc; www.alpeng.com.
   2. MiTek Industries, Inc; www.mii.com.
   3. Truswal Systems; www.truswal.com.
   4. Substitutions: See Section 01600 - Product Requirements.

B. Truss Fabricators:
   1. Stock Components, Salt Lake City, UT.
   2. BMC West, West Jordan, UT
   3. Burton Lumber, Salt Lake City, UT
   4. Truss Works, Lindon, UT
   5. Substitutions: See Section 01600 - Product Requirements.

2.02 MATERIALS

A. Lumber:
   1. Grade: RIS (GR), As required for structural loads
   2. Moisture Content: Between 7 and 9 percent.
   3. Lumber fabricated from old growth timber is not permitted.

B. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

2.03 ACCESSORIES

A. Wood Blocking, Bridging, Plates, and Miscellaneous Framing: Softwood lumber, any species, construction grade, 19 percent maximum and 7 percent minimum moisture content.

2.04 FABRICATION

A. Fabricate trusses to achieve structural requirements specified.

B. Brace wood trusses in accordance with TPI DSB-89 and BCSI 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that supports and openings are ready to receive trusses.

3.02 ERECTION

A. Install trusses in accordance with manufacturer's instructions and TPI DSB-89 and BCSI 1; maintain a copy of each TPI document on site until installation is complete.

B. Set members level and plumb, in correct position.

C. Install permanent bridging and bracing.

3.03 TOLERANCES

A. Framing Members: 1/2 inch (12 mm) maximum, from true position.

END OF SECTION 06173

SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

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 the following:

1. Laminate clad cabinets (plastic-covered casework).

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 6 Section "Miscellaneous Carpentry" for furring, blocking, exposed interior plywood panels, and other carpentry work which may or may not be exposed to view.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

C. Samples for initial selection purposes of the following in form of manufacturer's color charts consisting of actual units or sections of units showing full range of colors, textures, and patterns available for each type of material indicated.

1. Plastic laminate.

D. Samples for verification purposes of the following:

1. Laminate clad panel products, manufacturer standard sample for each type, color, pattern, and surface finish.
2. Corner pieces as follows:
   a. Cabinet front frame joints between stiles and rail as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.

3. Exposed cabinet hardware, one unit of each type and finish.

E. Product certificates signed by woodwork manufacturer certifying that products comply with specified requirements.

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.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm experienced in successfully producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to

produce required units without causing delay in the Work.

B. Single-Source Manufacturing and Installation Responsibility: Engage a qualified Manufacturer to assume undivided responsibility for woodwork specified in this section, including fabrication, finishing, and installation.

C. Installer Qualifications: Arrange for installation of architectural woodwork by a firm that can demonstrate successful experience in installing architectural woodwork items similar in type and quality to those required for this project.

D. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.

B. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Obtain and comply with Woodwork Manufacturer's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.

B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with manufacture of woodwork without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

PART 2 - PRODUCTS

2.1 HIGH PRESSURE DECORATIVE LAMINATE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high pressure decorative laminates which may be incorporated in the work include but are not limited to the following:

1. Formica Corp.
2. Nevamar Corp.
3. Ralph Wilson Plastics Co.
4. Wilsonart

2.2 MATERIALS

A. General: Provide materials that comply with requirements of the AWI woodworking standard for each type of woodwork and quality grade indicated and, where the following products are part of woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:

1. Hardboard: ANSI/AHA A135.4
2. High Pressure Laminate: NEMA LD 3.
3. Particleboard: ANSI A208.1

2.3 FABRICATION, GENERAL

A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation areas.

B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Edges of solid wood (lumber) members less than 1 inch in nominal thickness: 1/16 inch.
2. Edges of rails and similar members more than 1 inch in nominal thickness: 1/8 inch.

C. Complete fabrication, including assembly, finishing, and hardware application, before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

D. Factory cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water resistant coating.

2.4 LAMINATE CLAD CABINETS (PLASTIC-COVERED CASEWORK)

A. Quality Standard: Comply with AWI Section 400 and its Division 400B "Laminate Clad Cabinets."

B. Grade: Custom.

C. AWI Type of Cabinet Construction: Flush overlay.

D. Laminate Cladding: High pressure decorative laminate complying with the following requirements:

1. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   a. Match Architect's sample.

2. Laminate Grade for Exposed Surfaces: Provide laminate cladding complying with the following requirements for type of surface and grade.
   a. Horizontal Surfaces Other Than Tops: GP-50 (0.050-inch nominal

thickness).
b. Post-formed Surfaces: PF-42 (0.042-inch nominal thickness).
c. Vertical Surfaces: GP-50 (0.050-inch nominal thickness).
d. Edges: GP-50 (0.050-inch nominal thickness).

3. Semi-exposed Surfaces: Provide surface materials indicated below:
a. High pressure laminate, GP-28.

E. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers except where located directly under tops.

2.5 CABINET HARDWARE AND ACCESSORY MATERIALS

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Finish Hardware."

B. Cabinet Hardware Schedule: Refer to schedule at end of this section for cabinet hardware required for architectural cabinets.

C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA code number indicated.

1. Satin Stainless Steel, Stainless Steel Base: BHMA 630.

D. For concealed hardware provide manufacturer's standard finish that complies with product class requirements of ANSI/BHMA A156.9.

2.6 FASTENERS AND ANCHORS

A. Screws: Select material, type, size, and finish required for each use. Comply with FS FF-S-111 for applicable requirements.

1. For metal framing supports, provide screws as recommended by metal framing manufacturer.

B. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.

C. Anchors: Select material, type, size, and finish required by each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

2.7 FACTORY FINISHING OF INTERIOR ARCHITECTURAL WOODWORK

A. Quality Standard: Comply with AWI Section 1500 unless otherwise indicated.

B. General: The entire finish of interior architectural woodwork is specified in this section, regardless of whether factory applied or applied after installation.

1. Factory Finishing: To the greatest extent possible, finish architectural woodwork at factory. Defer only final touch-up, cleaning, and polishing until after installation.

C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of

architectural woodwork, as applicable to each unit of work.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before 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. Before installing architectural woodwork, examine shop fabricated work for completion and complete work as required, including back priming and removal of packing.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.

B. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 8'-0" for plumb and level (including tops) and with no variations in flushness of adjoining surfaces.

C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor woodwork 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. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

E. Cabinets: Install without distortion so that doors and drawers fit openings properly and are 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. Maintain veneer sequence matching (if any) of cabinets with transparent finish.

F. Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.

3.3 ADJUSTMENT AND CLEANING

A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and

Installer that ensures that woodwork is being without damage or deterioration at time of Substantial Completion.

3.5 HARDWARE SCHEDULE

A. Drawer Slides:
1. Type: Full extension, heavy duty.
2. Approved manufacturers:
   a. Accuride
   b. Knape and Vogt
   c. Blum

B. Shelf Standards:
1. Type: Recessed.
2. Approved Manufacturers:
   a. Knape and Vogt
   b. Grant Hardware.
   c. Or equal

C. Hinges:
1. Type: Self-closing concealed hinge.
2. Approved manufacturers:
   a. Blum,
   b. Mepla
   c. Hafele

D. Pulls:
1. Type: "D" pull, 4 inch centers, dull chrome finish.
2. Approved manufacturers:
   a. Baldwin
   b. Stanley
   c. Quality

END OF SECTION 06402

SECTION 06651 SOLID SURFACE FABRICATIONS

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 horizontal and trim solid surface product types:

1. Windowsills
2. Countertops
3. Backsplashes

B. Related Sections include the following:
1. Division 5 Section “Metal Fabrications” for supports.
2. Division 6 Section “Miscellaneous Carpentry” for Blocking.

1.3 DEFINITION

A. Solid surface is defined as nonporous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment.

1.4 SUBMITTALS

A. Product data:
1. For each type of product indicated.

B. Shop drawings:
1. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices and other components.
   a. Show full-size details, edge details, thermoforming requirements, attachments, etc.
   b. Show locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.

C. Samples:
1. For each type of product indicated.
   a. Submit minimum 6-inch by 6-inch sample in specified gloss.
   b. Cut sample and seam together for representation of inconspicuous seam.
   c. Indicate full range of color and pattern variation.
2. Approved samples will be retained as a standard for work.

D. Product data:
1. Indicate product description, fabrication information and compliance with specified performance requirements.

E. Product certificates:
1. For each type of product, signed by product manufacturer.

F. Manufacturer certificates:

1. Signed by manufacturers certifying that they comply with requirements.

G. Maintenance data:
1. Submit manufacturer's care and maintenance data, including repair and cleaning instructions.
   a. Maintenance kit for finishes shall be submitted.
2. Include in project closeout documents.

1.5 QUALITY ASSURANCE

A. Qualifications:
1. Shop that employs skilled workers who custom fabricate products similar to those required for this project and whose products have a record of successful in-service performance.

B. Applicable standards:
1. Standards of the following, as referenced herein:
   a. American National Standards Institute (ANSI)
   b. American Society for Testing and Materials (ASTM)
   c. National Electrical Manufacturers Association (NEMA)
   d. NSF International
2. Fire test response characteristics:
   a. Provide with the following Class A (Class I) surface burning characteristics as determined by testing identical products per UL 723 (ASTM E84) or another testing and inspecting agency acceptable to authorities having jurisdiction:
      1) Flame Spread Index: 25 or less.
      2) Smoke Developed Index: 450 or less.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver no components to project site until areas are ready for installation.

B. Store components indoors prior to installation.

C. Handle materials to prevent damage to finished surfaces.
1. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 WARRANTY

A. Provide manufacturer's warranty against defects in materials.
1. Warranty shall provide material and labor to repair or replace defective materials.
2. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted.
3. Warranty shall be transferable to subsequent owner for remainder of warranty period.

B. Manufacturer's warranty period:
1. Ten years from date of substantial completion.

1.8 MAINTENANCE

A. Provide maintenance requirements as specified by the manufacturer.

PART 2 — PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Subject to compliance with requirements, provide products by one of the following:
   a. Corian® surfaces from the DuPont company.
   b. Gibraltar from WilsonArt International
   c. Avonite surfaces from Aristech Acrylics LLC
   d. Others as approved by Architect prior to bidding.

2.2 MATERIALS

A. Solid polymer components
1. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.
2. Superficial damage to a depth of 0.010 inch (.25 mm) shall be repairable by sanding and/or polishing.

B. Thickness: 1/2 inch minimum.

C. Edge treatment: As indicated on drawings.

D. Performance characteristics:

Property	**Typical Result**	**Test**
Tensile Strength	6,000 psi	ASTM D 638
Tensile Modulus	1.5×10^{-6} psi	ASTM D 638
Tensile Elongation	0.4% min.	ASTM D 638
Flexural Strength	10,000 psi	ASTM D 790
Flexural Modulus	1.2×10^{-6} psi	ASTM D 790
Hardness	>85	Rockwell “M” Scale ASTM D 785
	56	Barcol Impressor ASTM D 2583
Thermal Expansion	3.02×10^{-5} in./in./°C (1.80×10^{-5} in./in./°F)	ASTM D 696
Gloss (60° Gardner)	5–75 (matte—highly polished)	ANSI Z124
Light Resistance	(Xenon Arc) No effect	NEMA LD 3-2000 Method 3.3
Wear and Cleanability	Passes	ANSI Z124.3 & Z124.6
Stain Resistance: Sheets	Passes	ANSI Z124.3 & Z124.6
Fungus and Bacteria Resistance	Does not support microbial growth	ASTM G21&G22
Boiling Water Resistance	No visible change	NEMA LD 3-2000 Method 3.5
High Temperature Resistance	No change	NEMA LD 3-2000 Method 3.6
Izod Impact (Notched Specimen)	0.28 ft.-lbs./in. of notch	ASTM D 256 (Method A)

Property	**Typical Result**	**Test**
Ball Impact Resistance: Sheets	No fracture—1⁄2 lb. ball: 1⁄4" slab—36" drop 1⁄2" slab—144" drop	NEMA LD 3-2000 Method 3.8
Weatherability	ΔE^*_{94}<5 in 1,000 hrs.	ASTM G 155
Specific Gravity †	1.7	
Water Absorption	Long-term 0.4% (3⁄4") 0.6% (1⁄2") 0.8% (1⁄4")	ASTM D 570
Toxicity	99 (solid colors) 66 (patterned colors)	Pittsburgh Protocol Test (“LC50”Test)
Flammability	All colors (Class I and Class A)	ASTM E 84, NFPA 255 & UL 723
Flame Spread Index	<25	
Smoke Developed Index	<25	

† Approximate weight per square foot: 1⁄4" (6 mm) 2.2 lbs. 1⁄2" (12.3 mm) 4.4 lbs 3/4” (18 mm) 6.6 lbs.
Shapes meet or exceed the ANSI Z124.3 and ANSI Z124.6 standards for plastic sinks and lavatories.
NEMA results based on the NEMA LD 3-2000

2.3 ACCESSORIES

A. Joint adhesive: Manufacturer’s standard one- or two-part adhesive kit to create inconspicuous, nonporous joints.

B. Sealant: Manufacturer’s standard mildew-resistant, FDA-compliant, NSF 51-compliant (food zone — any type), UL-listed silicone sealant in colors matching components.

2.4 FACTORY FABRICATION

A. Shop assembly
1. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer’s printed instructions and technical bulletins.
2. Form joints between components using manufacturer’s standard joint adhesive without conspicuous joints.
   a. Reinforce with strip of solid polymer material, 2" wide.
3. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings.
4. Rout and finish component edges with clean, sharp returns.
   a. Rout cutouts, radii and contours to template.
   b. Smooth edges.
   c. Repair or reject defective and inaccurate work.

2.5 FINISHES

A. Select from the manufacturer’s standard color chart.
1. Color: As selected by Architect from manufacturer’s full color range, including premium and custom colors. Refer to finish schedule in contract documents for project selected colors and manufacturer.

B. Finish:
1. Provide surfaces with a uniform finish.
a. Matte; gloss range of 5–20.

PART 3 — EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
1. Provide product in the largest pieces available.
2. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.
a. Exposed joints/seams shall not be allowed.

3. Reinforce field joints with solid surface strips extending a minimum of 1 inch on either side of the seam with the strip being the same thickness as the top.
4. Cut and finish component edges with clean, sharp returns.
5. Anchor securely to base cabinets or other supports.
6. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop.
7. Carefully dress joints smooth, remove surface scratches and clean entire and clean entire surface.

3.3 REPAIR

A. Repair or replace damaged work which cannot be repaired to architect's satisfaction.

3.4 CLEANING AND PROTECTION

A. Keep components clean during installation.

B. Remove adhesives, sealants and other stains.

END OF SECTION 06651

SECTION 07190 - WATER REPELLENTS

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 penetrating water-repellent coatings for the following vertical surfaces:
1. Concrete (unpainted).
2. Concrete unit masonry (unpainted and unglazed).

B. Related Sections include the following:
1. Division 3 Section "Cast-in-Place Concrete" for curing compounds, curing and sealing compounds, and penetrating liquid floor treatments.
2. Division 4 Section "Unit Masonry" for integral water-repellent admixture for unit masonry assemblies.
3. Division 7 Section "Joint Sealants."
4. Division 9 painting Sections for paints and coatings.

1.3 PERFORMANCE REQUIREMENTS

A. Performance Testing: Provide water repellents that comply with test-performance requirements indicated, as evidenced by reports of tests performed by manufacturer by a qualified independent testing agency on manufacturer's standard products applied to substrates simulating those on Project using same application methods to be used for Project.

B. Absorption: Minimum 80 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.
1. Concrete Unit Masonry: ASTM C 140..
2. Hardened Concrete: ASTM C 642.

C. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.

D. Permeability: Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, per ASTM D 1653.

E. Water Penetration and Leakage through Masonry: Maximum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.

F. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 154.

G. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
1. Reduction of Water Absorption: 80 percent.
2. Reduction in Chloride Content: 80 percent.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Manufacturer Certificates: Signed by manufacturers certifying that water repellents comply with requirements.

C. Qualification Data: For Installer.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.

E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 548 for testing indicated.

C. Test Application: Apply a finish sample for each type of water repellent and substrate required. Duplicate finish of approved sample.
1. Locate each test application as directed by Architect.
2. Size: 25 sq. ft. (2.3 sq. m).
3. Final approval by Architect of water-repellent application will be from test applications.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
1. Ambient temperature is above 40 deg F (4.4 deg C).
2. Concrete surfaces and mortar have cured for more than 28 days.
3. Concrete or brick masonry walls are not treated prior to 30 days after building close-in.
4. Rain or snow is not predicted within 24 hours.
5. Application proceeds more than seven days after surfaces have been wet.
6. Substrate is not frozen, or surface temperature is above 40 deg F (4.4 deg C).
7. Windy conditions do not exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer [and] Applicator] agree(s) to repair or replace materials that fail to maintain water repellency specified in Part 1 "Performance Requirements" Article within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 PENETRATING WATER REPELLENTS

A. Siloxane, Penetrating Water Repellent: Clear, oligomerous alkylalkoxysiloxanes containing 10 percent or more solids; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier; and with 3.3 lb/gal. (400 g/L) or less of VOCs. Provide repellents that are compatible with concrete masonry units containing integral water repellent, where occurs.
   1. Products:
      a. Chemical Products Industries, Inc.; CP-500W.
      b. ChemMasters; Spall Guard WB 10%.
      c. Chemprobe Coating Systems, L. P.; Prime A Pell H_2O.
      d. Diedrich Technologies, Inc.; 303-S.
      e. Euclid Chemical Company (The); Weatherguard.
      f. Hydrozo, a division of ChemRex; Enviroseal 40.
      g. ProSoCo, Inc.; Siloxane PD.
      h. SaverSystems, Div. of Meredith, Inc.; Masonry Saver WB.
      i. Specco Industries, Inc.; Waterstopper S-10 WB Siloxane.
      j. Wacker Chemical Corp.; 290, 2001, SMK 1311.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to water-repellent manufacturer's written instructions, to ensure that surface is dry enough.
   1. Cast-in-Place Concrete: Remove oil, curing compounds, laitance, and other substances that could prevent adhesion or penetration of water repellents.
   2. Clay Brick Masonry: Clean clay brick masonry per ASTM D 5703.

B. Test for pH level, according to water-repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.

C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.

D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
   1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.

1. Precast Concrete: At Contractor's option, first application of water repellent on precast concrete units may be completed before installing units. Mask sealant-bond surfaces to prevent water repellent from migrating onto joint surfaces.

C. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.3 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

END OF SECTION 07190

SECTION 07210 - BUILDING INSULATION

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. Perimeter wall insulation (supporting backfill).
2. Under floor slab insulation
3. Glass Fiber Blanket insulation
4. Rigid roof insulation.
5. Vapor retarders.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

C. Research/Evaluation Reports: For foam-plastic insulation.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, 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. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2. 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.

2.2 FOAM-PLASTIC BOARD INSULATION – CONCRETE PERIMETER FOUNDATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:

1. Manufacturers:

a. DiversiFoam Products.
b. Dow Chemical Company.
c. Owens Corning.
d. Pactiv Building Products Division.
e. Or, pre-approved equal.

2. Perimeter Walls: Type IV, 1.60 lb/cu. Ft.

2.3 GLASS-FIBER BLANKET INSULATION – CAVITY WALLS

A. Manufacturers:

1. CertainTeed Corporation.
2. Guardian Fiberglass, Inc.
3. Johns Manville.
4. Knauf Fiber Glass.
5. Owens Corning.
6. Or, pre-approved equal.

B. Glass-Fiber-Blanket Insulation: Thermal insulation, complying with ASTM C 991, Type II, of 0.5-lb/cu. ft. density, thickness as indicated, with a flame-spread rating of 25 or less, and 2-inch wide, continuous, vapor-tight edge tabs.

1. Type II: Faced one side with non-reflective vapor-retarder membrane. Class A: Membrane-faced surface with a flame-spread rating of 25 or less.
2. Type II: 1.35-lb/cu. ft. minimum density.
3. Type II: Applied with a water based liquid adhesive.

C. Vapor-Retarder Facing: Complying with ASTM C 1136, with permeance not greater than the following when tested according to ASTM E 96, Desiccant Method:

1. Composition: Semi-gloss White Polypropylene-faced, scrim-reinforced foil, with permeance not greater than 0.02 perm.

2. 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. Lamtec Corporation.
   b. Owens-Corning Fiberglas Corporation.

   c. Simple Saver System as designed by Thermal design, Inc. (800-255-0776).

2.4 UNDER SLAB INSULATION AND RADIANT BARRIER

A. Basis of Design: "The Barrier X5" as manufactured by Northwestern Ohio Foam Products, Inc. 800-339-4850; or equal if approved in advance of bidding by the Architect.

1. High-performance extruded expanded polystyrene foam, vapor retarding film, self-taping edge and overlapping flange.
2. Conform to:
   a. ASTM C C-518 – Insulation R-Value – 5.3/5.0 (material only).
   b. ASTM D 1621 – Compressive Resistance – 13-15 psi @ 10%.
   c. ASTM E 96 Section B – Permeance – Zero.
   d. ICBO Section 4.6.1 – Water Permeability – Zero.
3. Thickness, Nominal: 1.25 inches.
4. Weight (per unit): 40 lbs.
5. Size/Coverage: 4'x60' / 240 sq.ft.
6. Maximum Use Temperature: 180 Deg. F.

2.5 RIGID BOARD INSULATION - INTERIOR WALLS

A. Rigid Foam Board Insulation: closed cell polyisocyanurate foam board with glass fiber reinforced core, to [ASTM C1289, Type I, Class 2] [and] [Federal Specification HH-I-1972/1, Class 2]; meeting the following criteria:

1. Basis of Design: THERMAX™ Insulated Sheathing as manufactured by The Dow Chemical Company; 1-866-583-2583; http://building.dow.com.

2. Thermal Resistance [(ASTM C1363 @ 75 deg. F)] [(ASTM C518 @ 75 deg. F)]: R-6.5 per 1 inch of thickness (RSI 1.14 per 25 mm of thickness).

3. Density (ASTM D1622): nominal 2.0 pcf.

4. Compressive Strength (ASTM D1621): minimum 25 psi.

5. Board Sizes: minimum 48 inches (1,220 mm) wide, 96 inches (2,440 mm).

6. Board Thickness: to achieve minimum R-value as indicated on Drawings.

7. Board Edges: Shiplapped.

8. Faces: 1.0 mil (0.025 mm) thick aluminum foil facer, both sides.

9. Foam Surface Burning Characteristics (ASTM E84): flame spread < 25, smoke developed < 450.

10. Water Vapor Transmission (ASTM E96): less than 0.03 perms.

11. Water Absorption by Volume (ASTM C209): maximum 0.3 percent.

2.6 RIGID BOARD INSULATION - ROOFS

B. Polyisocyanurate Board Insulation: ASTM D 1621, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:

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. IKO.
b. Dow Chemical Company.
c. Dyplast.
a. Or, pre-approved equal.

2.7 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.6 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:

1. Products:

a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
b. Eckel Industries of Canada; Stic-Klip Type N Fasteners.
c. Gemco; Spindle Type.
d. Or, pre-approved equal.

2. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

3. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

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 for other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering 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 and that has not been left exposed at any time to ice, rain, and snow.

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. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF PERIMETER INSULATION

A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

1. Extend insulation a minimum of 24 inches below exterior grade line, unless noted otherwise.

B. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.

3.5 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. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Set vapor-retarder-faced units with vapor retarder to warm-in winter side of construction, unless otherwise indicated.

1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

3.6 INSTALLATION OF VAPOR RETARDERS (INCLUDES VAPOR RETARDER / RADIANT BARRIER)

A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.

C. Before installing vapor retarder, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in

vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.

D. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

E. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.

F. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.7 PROTECTION

A. Protect installed insulation and vapor retarders 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 07210

SECTION 07410 - ROOFING, GUTTERS & FLASHING

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.

B. See Insulation Section for roof insulation.

1.2 SUMMARY

A. This Section includes basic performance requirements for any roofing system that may be proposed including roofing accessories not limited to the following: fascias, copings, flashing, gutters, downspouts and other miscellaneous roof accessories.

B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 5 Sections for Structural Steel and Cold-Formed Metal framing.
2. Division 6 Section “Miscellaneous Carpentry
2. Division 7 Section "Building Insulation" for roof and wall insulation.
3. Division 7 Section "Joint Sealants" for field-applied panel sealants.
4. Division 7 Section “Roof Snow Guards.
5. Division 16 Section “Snow Melting System.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide certified test results by a recognized testing laboratory or agency in accordance with specified test methods for each system.

B. Conform to SMACNA Architectural Sheet Metal Manual for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.

C. Conform to DFCM General Conditions requirements.

1.4 REFERENCE STANDARDS

A. Comply with Industry reference standards applicable for the product to be utilized.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data including manufacturer's product specifications, standard details, certified product test results, installation instructions, and general recommendations, as applicable to materials and finishes for each component and for total panel system.

C. Samples for initial selection purposes in form of manufacturer's color charts or chips showing full range of colors, textures, and patterns available for roof panels with factory-applied finishes.

D. Shop Drawings showing layouts of panels on roofs, wall, details of edge conditions, joints, corners, panel profiles, supports, anchorages, trim, flashings, closures, and special details. Distinguish between factory and field assembly work.

1.6 QUALITY ASSURANCE

A. Wind Uplift: Provide roof panel system including supports meeting requirements of Underwriters Laboratories, Inc. for minimum Class 90 wind uplift resistance UL 580, Fourth Edition for the construction specified; and also comply to the requirements of the requirements of the Structural Engineer Basis of Design for Wind Design, as indicated in the project documents. Conform to whichever is the more stringent.

B. Field Measurements: Where possible, prior to fabrication of panels, take field measurements of structure or substrates to receive panel system. Allow for trimming panel units where final dimensions cannot be established prior to fabrication.

C. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.

1.7 WARRANTY

A. Warranty:
0. Furnish manufacturer's standard warranty covering failure of the material and/or finish. This warranty shall be in addition to and not a limitation of other rights the End User may have against the Contractor under the Contract Documents.
a) Warranty period is 20 year NDL (no dollar limit) if available.
2. A five (5) year DFCM Contractor warranty is required on all roofs. Contractor and roofing sub-contractor shall complete and submit the DFCM "Contractor Roofing Warranty" form accordingly. Any other DFCM General Conditions shall also apply.

1.8 DELIVERY, STORAGE AND HANDLING

A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.

B. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers that have offered roof products of the type proposed for the project that have a history of at least twenty (20) continuous years manufacturing in the roof products for the industry.

2.2 MATERIALS

A. Roofing and accessories compliant with requirements.
1. Accessories: Except as indicated as work of another specification section, provide components required for a complete roof system, including trim, copings, fascias, corner units, ridge closures, clips, seam covers, battens, flashings, sealants, gaskets, fillers, closure strips, and similar items.

2.4 GUTTERS & DOWNSPOUTS (IF REQUIRED)

A. COMPONENTS
1. Gutters: Custom profile as indicated on the drawings.
2. Downspouts: Custom profile as indicated on the drawings.
3. Anchors and Supports: Profiled to suit gutters and downspouts.

a. Anchoring Devices: In accordance with SMACNA requirements.
b. Gutter Supports: Straps.
c. Downspout Supports: Brackets.

4. Fasteners: Galvanized steel, with soft neoprene washers.
5. Gutter Screens – continuous.

B. FABRICATION

1. Form gutters and downspouts of profiles and size indicated.
2. Fabricate with required connection pieces.
3. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
4. Hem exposed edges of metal.
5. Fabricate gutter and downspout accessories; seal watertight.

C. FACTORY FINISHING

1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; color as scheduled.

2.5 FLASHING

A. ACCESSORIES:

1. Fasteners: Galvanized steel, with soft neoprene washers.
2. Primer: Zinc chromate type.
3. Protective Backing Paint: Zinc molybdate alkyd.
4. Sealant: Type “ES2” specified in Section 07900.
5. Plastic Cement: ASTM D 4586, Type I.

B. FABRICATION

1. Form sections true to shape, accurate in size, square, and free from distortion or defects.
2. Form pieces in longest possible lengths.
3. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
4. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
5. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.
6. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.

PART 3 - EXECUTION

3.1 ROOFING

A. General: Comply with manufacturers' instructions and recommendations for installation, as applicable to project conditions and supporting substrates.

B. Accessories: Install components required for a complete roof system, including trim, copings, fascias, gravel stops, mullions, sills, corner unite, ridge closures, clips, seam covers, battens, flashings, gutters, louvers, sealants, gaskets, fillers, closure strips, and similar items.

C. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of panel systems. Provide types of gaskets, sealants, and fillers indicated or, if not otherwise indicated, types recommended by panel manufacturer.

1. Provide weatherseal under ridge cap. Flash and seal roof panels at eave and rake with rubber, neoprene, or other closures to exclude weather.

2. Refer to other sections of these specifications for product and installation requirements applicable to indicated joint sealers.

D. CLEANING AND PROTECTION
1. Damaged Material: Replace any components of the work that have been damaged or have deteriorated beyond successful repair by means recommended by the manufacturer.
2. Cleaning: In accordance with manufacturer's requirements and maintain in a clean condition during construction.

3.2 GUTTERS AND DOWNSPOUTS

A. EXAMINATION: Verify existing conditions before starting work.

B. PREPARATION - Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

C. INSTALLATION:
1. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
2. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
3. Slope gutters 1/16 inch per foot (6.35 mm/m).

3.3 FLASHING

A. EXAMINATION:
1. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
2. Verify roofing termination and base flashings are in place, sealed, and secure.

B. PREPARATION:
1. Install starter and edge strips, and cleats before starting installation.
2. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

C. INSTALLATION:
1. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
2. Apply plastic cement compound between metal flashings and felt flashings.
3. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

END OF SECTION 07410

SECTION 07729 – ROOF SNOW GUARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Snow rail for standing seam metal roofs.

1. Snow Guard system consists of snow guard block and flag assembly set screws.
2. Aluminum Tubing
3. Couplings.
4. End Plugs.
5. Ice Flags.
6. End Collars

1.2 RELATED SECTIONS

A. Section 07410 - Manufactured Roof Panels, Gutters and Flashing

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Snow guard placement layout for pitch and run of roof as required to retain snow in place.

D. Color Selection Samples: For each application specified, provide two complete sets of color chips to match roof color..

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.5 WARRANTY

A. Provide manufacturers standard 2 year warranty.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis for Design: Alpine Snow Guards, A Division of Vermont Slate and Copper Services, Inc., which is located at: 289 Harrell St., Morrisville, VT; Toll Free Tel: 888-766-4273; Fax: 888-766-9994; Email: info@alpinesnowguards.com; Web: www.alpinesnowguards.com

B. Substitutions: The similar products of other manufacturers will be considered in accordance with provisions of Section 01631.

2.2 MATERIALS

A. Snow Guard block and flag: Extruded and milled 6061-T6 aluminum, non-penetrating attachment to standing seam.

B. Tubing: 6061-T6, 1” outside diameter and 1/8” wall thickness extruded aluminum.

C. Couplings: 6061-T6 aluminum 5” long.

D. End Caps: 302 stainless steel.

E. Ice Flags: 6061-T6 aluminum, 3” wide and depth as required. 2 per panel space

F. End Collars: 6061-T6 aluminum.

G. Fasteners: 304 stainless steel.

2.3 FINISH

A. Coating by manufacturer to match color of metal roof panels.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until the metal roofing system has been completely installed.

B. If metal roof system installation is the responsibility of another installer, notify Contractor and Architect of unsatisfactory conditions before proceeding.

3.2 INSTALLATION

A. Comply with Architectural drawings and with manufacturer’s instructions and recommendations for installation.

B. Seam Mounting: Place snow guard over roof panel seams in the approved layout pattern. Tighten set-screws with hex bit sockets and 3/8 inch (9.5 mm) drive ratchet until fully engaged.

3.3 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 07729

SECTION 07841 - THROUGH-PENETRATION FIRESTOP SYSTEMS

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 through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

B. Related Sections include the following:

1. Division 7 Section "Fire-Resistive Joint Systems."
2. Division 15 Sections specifying duct and piping penetrations.
3. Division 16 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

C. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

C. Qualification Data: For Installer.

D. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.

E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers:

1. A/D Fire Protection Systems Inc.
2. Grace, W. R. & Co. - Conn.
3. Hilti, Inc.
4. Johns Manville.
5. Nelson Firestop Products.
6. NUCO Inc.
7. Specified Technologies Inc.
8. 3M; Fire Protection Products Division.
9. Tremco; Sealant/Weatherproofing Division.
10. USG Corporation.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:

   a. Slag-/rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.

4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

F. Intumescent Putties: Non-hardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.

I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.6 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

A. Firestop Systems with No Penetrating Items:

1. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Silicone sealant.
c. Intumescent putty.
d. Mortar.

B. Firestop Systems for Metallic Pipes, Conduit, or Tubing:

1. Type of Fill Materials: One or more of the following:

a. Latex sealant.

b. Silicone sealant.
c. Intumescent putty.
d. Mortar.

C. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:

1. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Silicone sealant.
c. Intumescent putty.
d. Intumescent wrap strips.
e. Firestop device.

D. Firestop Systems for Electrical Cables:

1. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Silicone sealant.
c. Intumescent putty.
d. Silicone foam.
e. Pillows/bags.

E. Firestop Systems for Insulated Pipes:

1. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Intumescent putty.
c. Silicone foam.
d. Intumescent wrap strips.

F. Firestop Systems for Miscellaneous Electrical Penetrants:

1. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Intumescent putty.
c. Mortar.

G. Firestop Systems for Miscellaneous Mechanical Penetrants:

1. Type of Fill Materials: One or both of the following:

a. Latex sealant.
b. Mortar.

H. Firestop Systems for Groupings of Penetrants:

1. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Mortar.
c. Intumescent wrap strips.
d. Firestop device.
e. Intumescent composite sheet.

END OF SECTION 07841

SECTION 07842 - FIRE-RESISTIVE JOINT SYSTEMS

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 fire-resistive joint systems for the following:

1. Floor-to-floor joints.
2. Floor-to-wall joints.
3. Head-of-wall joints.
4. Wall-to-wall joints.

B. Related Sections include the following:

1. Division 7 Section "Building Insulation" for floor-to-wall joints indicated as perimeter fire-containment systems between perimeter edge of fire-resistance-rated floor assemblies and back of non-fire-resistance-rated exterior curtain walls.
2. Division 7 Section "Roof Expansion Assemblies" for fire-resistive roof expansion assemblies.
3. Division 7 Section "Through-Penetration Firestop Systems" for systems installed in openings in walls and floors with and without penetrating items.
4. Division 7 Section "Joint Sealants" for non-fire-resistive joint sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities and L-ratings indicated as determined by UL 2079.

1. Load-bearing capabilities as determined by evaluation during the time of test.

C. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to

authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

C. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Evaluation Reports: Evidence of fire-resistive joint systems' compliance with ICBO ES AC30, from the ICBO Evaluation Service.

G. Research/Evaluation Reports: For each type of fire-resistive joint system.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:

   a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify Owner's inspecting agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector of authorities having jurisdiction have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, fire-resistive joint systems that may be incorporated into the Work include, but are not limited to, those systems indicated in the Fire-Resistive Joint System Schedule at the end of Part 3.

B. Available Manufacturers: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers:

1. A/D Fire Protection Systems Inc.
2. Grace, W. R. & Co. - Conn.
3. Johns Manville.
4. Nelson Firestop Products.
5. 3M; Fire Protection Products Division.
6. USG Corporation.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

B. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Engage a qualified independent inspecting agency to inspect fire-resistive

joint systems and prepare inspection reports.

B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.

1. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.

C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.

D. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.6 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

A. Head-of-Wall and Wall-to-Wall Fire-Resistive Joint Systems:

1. Assembly Rating: 2 hours.
2. Joint Width: As indicated.
3. Movement Capabilities: Class II - 50 percent compression or extension.

END OF SECTION 07842

SECTION 07901 - 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 as indicated below:
   a. Control and expansion joints in cast-in-place concrete.
   b. Perimeter of door, window and mechanical openings.

2. Exterior joints in horizontal traffic surfaces as indicated below:
   a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
   b. Other joints as indicated.

3. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:
   a. Perimeter joints of exterior openings where indicated.
   b. Tile control and expansion joints.
   c. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
   d. Perimeter joints of toilet fixtures.
   e. 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. Control and expansion joints in tile flooring.
   c. Other joints as indicated.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 8 "Glazing" for sealants used in glazing.
2. Division 9 Section "Tile" for sealing tile joints.

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 and Division 1 Specification Sections.

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. Qualification data complying with requirements specified in "Quality Assurance" article. Include list of completed projects with project names addresses, names of Architects and Owners, plus other information specified.

F. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

G. Product test reports for each type of joint sealants indicated, evidencing compliance with requirements specified.

H. Preconstruction field test reports indicating which products and joint preparation methods demonstrate acceptable adhesion to joint substrates.

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 multi-component 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 to occur not less than 21 or more than 30 days after completion of waterproofing, unless otherwise indicated.

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. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and other requirements indicated on each Elastomeric Joint Sealant Data Sheet at end of this Section, including those requirements referencing ASTM C 920 classifications for Type, Grade, Class, and Uses.

1. Additional Movement Capability: Where additional movement capability is specified in Elastomeric Joint Sealant Data Sheet, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements of ASTM C 920 for Uses indicated.

B. Available Products: Subject to compliance with requirements, elastomeric sealants that may be incorporated in the Work include, but are not limited to, the products specified in each Elastomeric Sealant Data Sheet.

2.3 LATEX JOINT SEALANTS

A. General: Provide manufacturer's standard one-part, nonsag, mildew-resistant, paintable latex sealant of formulation indicated that is recommended for exposed applications on interior and protected exterior locations and that accommodates indicated percentage change in joint width existing at time of installation without failing either adhesively or cohesively.

B. Acrylic-Emulsion Sealant: Provide product complying with ASTM C 834 that accommodates joint movement of not more than 5 percent in both extension and compression for a total of 10 percent.

C. Available Products: Subject to compliance with requirements, latex joint sealants that may be incorporated in the Work include, but are not limited to, the following:

1. Acrylic-Emulsion Sealant:
   a. "AC-20," Pecora Corp.
   b. "Sonolac," Sonneborn Building Products Div., ChemRex, Inc.
   c. "Tremco Acrylic Latex 834," Tremco, Inc.

2.4 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 material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Open-cell polyurethane foam.

2.5 JOINT FILLERS FOR CONCRETE PAVING

A. General: Provide joint fillers of thickness and widths indicated.

B. Bituminous Fiber Joint Filler: Performed strips of composition below, complying with ASTM D 1751:

1. Asphalt saturated fiberboard.

2.6 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: Non-staining, 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.

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.

ELASTOMERIC JOINT SEALANT DATA SHEET

Elastomeric Joint Sealant Designation: ES-1

Base Polymer: Urethane.

Type: S (single component).

Grade: P (pourable).

Class: 25.

Use Related to Exposure: T (traffic).

Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated.

Use O Joint Substrates: Galvanized steel, brick, concrete, ceramic tile, and wood.

Available Products: "NR-201 Urexpan," Pecora Corp.; "Vulkem 45," Mameco; "Sonolastic SL 1, " Sonneborn Building Products Division.

ELASTOMERIC JOINT SEALANT DATA SHEET

Elastomeric Joint Sealant Designation: ES-2

Base Polymer: Urethane silicone.

Type: M (multi component).

Grade: NS (nonsag).

Class: 25.

Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.

Use Related to Exposure: NT (nontraffic).

Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

Use O Joint Substrates: Coated glass, color anodized aluminum, aluminum coated with a

high-performance coating, galvanized steel, brick, ceramic tile, and wood.

Available Products: "Dynatrol II," Pecora Corp.; "Vulkem 922," Mameco; Sonolastic NP2," Sonneborn Building Products Division.

ELASTOMERIC JOINT SEALANT DATA SHEET

Elastomeric Joint Sealant Designation: ES-3

Base Polymer: Acid-curing silicone.

Type: S (single component).

Grade: NS (nonsag).

Class: 25.

Use Related to Exposure: NT (nontraffic).

Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.

Use O Joint Substrates: Coated glass, color anodized aluminum, aluminum coated with a high-performance coating, galvanized steel, brick, and ceramic tile.

Available Products: "786 Mildew Resistant," Dow Corning; "Sanitary 1700," GE Silicones.

JOINT SEALANT SCHEDULE		
SEALANT DESIGNATIONS	JOINT SEALERS	DESCRIPTION OF JOINT CONSTRUCTION AND LOCATION WHERE SEALANT IS TYPICALLY APPLIED*.
ES1	One-Part Pourable Urethane Sealant	Exterior and interior joints in horizontal surfaces of concrete; between metal and concrete, mortar and masonry.
ES2	Multi-Part Nonsag Urethane Sealant	Exterior and interior joints in vertical surfaces of concrete and masonry; between metal and concrete or mortar; interior and exterior perimeter joints of metal frames in exterior walls; exterior overhead joints.
ES3	One-Part Mildew-Resistant Silicone Sealant	Interior joints in vertical surfaces of ceramic tile in toilet rooms, and perimeter of plumbing fixture/ceramic tile joints.
LS	Acrylic-Emulsion Sealant	Interior joints in field-painted vertical and overhead surfaces at perimeter of hollow metal door frames; in gypsum drywall, plaster, concrete, and concrete masonry; and all other interior joints not indicated otherwise.
* Install sealant indicated in joints fitting descriptions listed.		

END OF SECTION 07901

SECTION 08111 - STANDARD STEEL DOORS AND FRAMES

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 the following products manufactured in accordance with SDI Recommended Standards:

1. Doors: Seamless, hollow or composite construction standard steel doors for interior and exterior locations.
2. Frames: Pressed steel frames for doors, transoms, sidelights, mullions, interior glazed panels, and other interior and exterior openings of following type:

a. Welded unit type.

3. Assemblies: Provide thermal rated (insulated) doors where indicated.
4. Provide factory primed doors and frames to be field painted.

B. Painting primed doors and frames is specified in Division 9 Section "Painting."

C. Door hardware is specified in another Division 8 Section.

D. Glass vision panels.

E. Division 13 “Metal Building Systems” to coordinate installation.

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 door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.

C. Shop drawings showing fabrication and installation of standard steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

1. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.
2. Indicate coordinate of glazing frames and stops with glass and glazing requirements.

1.4 QUALITY ASSURANCE

A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications Standard Steel Doors and Frames" ANSI/SDI-100 and as herein specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4-inches high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inches spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering standard steel doors and frames which may be incorporated in the work include; but are not limited to, the following:
1. Standard Steel Doors and Frames:
a. Amweld Building Products, Inc.
b. Ceco Corp.
c. Fenestra Corp.
d. Republic Builders Products.
e. Steelcraft Manufacturing Co.
f. Curries
g. Or, pre-approved equal.

2.2 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, or drawing quality, ASTM A 642, hot dipped galvanized in accordance with ASTM A 525, with A60 or G60 coating designation, mill phosphatized.

D. Supports and Anchors: Fabricate of not less than 18-gage sheet steel; galvanized where used with galvanized frames.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize in compliance with ASTM A 153, Class C or D as applicable.

F. Shop Applied Paint: Apply after fabrication.

1. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A224.1, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

2.3 DOORS

A. Provide metal doors of SDI grades and models specified below or as indicated on drawings or schedules:

1. Interior Doors: ANSI/SDI-100, Grade II, heavy-duty, Model 3 or 4, minimum 18-gage cold-rolled sheet steel faces.
2. Exterior Doors: ANSI/SDI-100, Grade III, extra heavy-duty, Model 4, minimum 16-gage galvanized steel faces.

2.4 FRAMES

A. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on drawings and schedules. Conceal fastenings, unless otherwise indicated. Fabricate frames of minimum 18-gage cold-rolled steel.

1. Fabricate frames with mitered or coped corners, welded construction for all applications.
2. Form exterior frames from 14-gage galvanized steel.

B. Door Silencers: Except on weather stripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.

C. Plaster Guards: Provide minimum 26-gage steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

2.5 GLASS

A. Uncoated, Clear, Heat-Treated Float Glass: ASTM C 1048, Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below.

2. Kind FT (fully tempered) where indicated.

2.6 FABRICATION

A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory- assembled before shipment, to assure proper assembly at project site. Comply with ANSI/SDI-100 requirements.

1. Internal Construction: Manufacturer's standard honeycomb, polyurethane, polystyrene, unitized steel grid, vertical steel stiffeners, or rigid mineral fiber core with internal sound deadener on inside of face sheets where appropriate in accordance with SDI standards.

2. Clearances: Not more than 1/8 inch at jambs and heads except between non-fire-rated pairs of doors not more than 1/4 inch. Not more than 3/4 inch at bottom.

B. Fabricate exposed faces of doors and panels, including stiles and rails of non-flush units, from only cold-rolled steel.

C. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and

Frames."

D. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel.

E. Fabricate exterior doors, panels, and frames from galvanized sheet steel in accordance with SDI-112. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 16-gage inverted steel channels.

F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

G. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 236 or ASTM C 976 on fully operable door assemblies.

1. Unless otherwise indicated, provide thermal-rated assemblies with U factor of 0.41 Btu/(hr x sq ft x deg F.) or better.

H. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 Series Specifications for door and frame preparation for hardware.

I. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at project site.

J. Locate hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames," published by Door and Hardware Institute.

K. Shop Painting: Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.

1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

2. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

L. Glazing Stops: Minimum 20 gage steel or .040-inch-thick aluminum.

1. Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.

2. Provide screw applied removable glazing beads on inside of glass, louvers, and other panels in doors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install standard steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.

B. Placing Frames: Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames," unless otherwise indicated.

1. Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

2. In masonry construction, locate 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry Tee anchors.

C. Door Installation: Fit hollow metal doors accurately in frames, within clearances specified in ANSI/SDI-100.

3.2 ADJUST AND CLEAN

A. Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Protection Removal: Immediately prior to final inspection, remove protective plastic wrappings from pre-finished doors.

C. Final Adjustments: Check and readjust operating hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION 08111

SECTION 08360 - 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 steel frame and steel panel sectional overhead doors, electric motor-operated.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

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.

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, operators, and installation accessories.

B. Inserts and Anchorages: Furnish inserts and anchoring devices that must be set in concrete or built into masonry for unit installation. Provide setting drawings, templates, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

C. See concrete and masonry Sections for instruction on installing inserts and anchorage devices.

D. Wind Loading: Design and reinforce sectional overhead doors to withstand a 20-psf wind-loading pressure.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Overhead Door Corp.
2. Raynor Garage Door Co.
3. Windsor Republic Door.
4. Or, pre-approved equal

2.2 STEEL SECTIONS

A. Construct door sections from galvanized, structural-quality carbon steel sheets complying with ASTM A 446, Grade A, or ASTM A 526, with a minimum yield strength of 33,000 psi, and a minimum G60 zinc coating complying with ASTM A 525.

1. Steel Sheet Thickness: 0.0396 inch (20 gage).

B. Fabricate sections from a single sheet to provide units not more than 24 inches high, and nominally 2 inches deep. Roll horizontal meeting edges to a continuous shiplap, rabbeted, or keyed weather seal, with a reinforcing flange return.

C. Enclose open section with 16-gage galvanized steel channel, end stiles welded in place. Provide intermediate stiles, cut to door section profile, spaced at not more than 48 inches o.c. and welded in place.

D. Reinforce bottom section with a continuous channel or angle conforming to bottom section profile.

E. Reinforce sections with continuous horizontal and diagonal reinforcing, as required by door width and design wind loading. Provide galvanized steel bars, struts, trusses or strip steel, formed to depth, and bolted or welded in place.

F. Insulate inner core of steel sections with manufacturer's standard foam type insulation.

1. Enclose insulation with manufacturer's standard steel sheet secured to door panel.
2. U-value: 0.05727 BTU. = R-Value 17.60

G. Finish door sections as follows:

1. Apply manufacturer's standard prime coat, applied to both door faces after forming. Finish door with 2 coats baked on finish. See drawings for color selection.

2.3 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Provide manufacturer's 3” heavy duty, galvanized-steel track system, and 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. Slot vertical sections of track at 2 inches o.c. for door-drop safety device. 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.

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 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 continuous flexible seals at door jamb edges for a fully weathertight installation

E. Insulated Vision Panels: Provide pre-assembled clear float-glass or plastic vision panels in arrangement shown. Set glass in rubber or neoprene channel glazing strips. Provide removable stops of same material at door section frames.

1. Vision Panel Thickness: 5/8 inches.

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. Provide double-end hinges, where required, for doors exceeding 16 feet in width, unless otherwise recommended by door manufacturer.

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.

2.5 COUNTERBALANCING MECHANISM

A. Torsion Spring: Operation by torsion-spring counterbalance mechanism, consisting of adjustable-tension, tempered-steel torsion springs mounted on a case hardened 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 16 feet long and two additional brackets at one-third points to support shafts over 16 feet long, unless closer spacing recommended by door manufacturer.

C. Include a spring-loaded, steel or bronze cam mounted to bottom door roller assembly on each side, designed to automatically stop door if either cable breaks.

D. 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, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations and control devices.

B. Provide hand-operated disconnect or mechanism for automatically engaging sprocket-chain operator and releasing brake for emergency manual operation. Include interlock device to automatically prevent motor from operating when emergency sprocket is engaged.

C. Design operator so that motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator

D. Door Operator Type: Provide the following:

1. Center mounted Jack Shaft Operator with solenoid activated primary drive and chain and sprocket secondary drive at the side of the door.

E. 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 or more than 1 foot per second.

1. Coordinate wiring requirements and current characteristics of motors with building electrical system.
2. Provide totally enclosed, non-ventilated-type motors, fitted with plugged drain, and controller with NEMA Type 4 enclosure where required.

F. Remote Control Station: Provide momentary-contact, three-button control station with push button controls labeled "Open," "Close," and "Stop."

1. Provide interior units, full-geared, surface-mounted, heavy-duty, with general purpose NEMA Type 1 enclosure.
2. Provide remote control transmitters.

a. Quantity: 2 per door.

G. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensors able to protect full width of door opening. Activation of sensor immediately stops and reverses downward door travel.

1. Photoelectric Sensor: Manufacturer’s standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Provide self-monitoring sensor designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door operates to close only with constant pressure on close button.

H. Manual Operation/Release: Manual pull rope/chain, accessible from finish floor at the side of the door.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install door, track, 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 framing at not less than 24 inches o.c. Hang horizontal track from structural overhead framing with angle or channel hangers, welded and 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. Provide conduit for all required wiring.

END OF SECTION 08360

SECTION 08574 - FIBERGLASS WINDOWS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fiberglass sliding windows.
B. Fiberglass Fixed Window (fixed sash in frame).

1.2 RELATED SECTIONS

A. Section 07901 - Joint Sealants: Sealants and caulking.

1.3 REFERENCES

A. American Architectural Manufacturers Association (AAMA):
   1. AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Doors.
   2. AAMA 613 - Voluntary Performance Requirements and Test Procedures for Organic Coatings on Plastic Profiles.

B. American Society for Testing and Materials (ASTM):
   1. ASTM C 1036 - Flat Glass.
   2. ASTM C 1048 - Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass.
   3. ASTM D 3656 - Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns.
   4. ASTM E 283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen.
   5. ASTM E 547 - Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential.

C. Screen Manufacturers Association (SMA):

   1. SMA 1201 - Specifications for Insect Screens for Windows, Sliding Doors and Swinging Doors.

D. Window and Door Manufacturers Association (WDMA):

   1. ANSI/AAMA/NWWDA 101/I.S.2 - Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.

1.4 PERFORMANCE REQUIREMENTS

A. Sliding Windows shall meet minimum Performance Class and Grade Rating HS-LC30 specifications in accordance with ANSI/AAMA/NWWDA 101/I.S.2.

B. Fixed Windows shall meet minimum Performance Class and Grade Rating F-CW50 specifications in accordance with ANSI/AAMA/NWWDA 101/I.S.2.

C. Window Air Leakage, ASTM E 283: Window air leakage when tested at 1.57 psf (25 mph) shall be 0.25 cfm/ft^2 of frame or less.

D. Window Water Penetration, ASTM E 547: No water penetration through window when tested under static pressure of 4.5 psf (42 mph) after 4 cycles of 5 minutes each, with water being applied at a rate of 5 gallons per hour per square foot.

1.5 SUBMITTALS

A. Submit in accordance with Division 1 requirements.

B. Product Data: Submit manufacturer's product data, including installation instructions

C. Product Sample: For each exposed product and for each color specified, provide cross section and color chip samples at least 2”x4” samples for color and product verification of White Fiberglass material.

D. Shop Drawings: Submit manufacturer's shop drawings, indicating dimensions, construction, component connections and locations, anchorage methods and locations, hardware locations, and installation details.

E. Certifications: Certification prior to installation from independent certification companies—AAMA, or WDMA acceptable certification, with Certification Sticker to be secured on each window unit delivered.

1.6 WARRANTY

A. Manufacturer’s Warranty: Manufacturer agrees to repair or replace fiberglass windows that fail in Materials or workmanship within a specified warranty period as follows in accordance with manufacturer’s submitted warranty.

1. Warranty Period
   a. Window and Non-Glass components: 10 years from substantial completion
   b. Glazing Units: 20 years from substantial completion.

B. Samples: Submit full-size or partial full-size sample of window illustrating glazing system, quality of construction, and color of finish.

C. Certifications: Provide 3rd party independent testing results verifying Performance Class and Performance Grade for the submitted window, showing necessary documentation of the windows ratings. Only AAMA and WDMA certifications and testing to be allowed unless other-wise pre-approved by the Architect.

1.7 QUALITY ASSURANCE

A. MOCK-UP

1. Provide sample installation to determine acceptability of window installation and to show interaction with the other building materials and to ensure proper integration according to the shop drawings. MOCK-UP MUST UTILIZE THE CLIP INSTALLATION METHOD FOR SET-BACK REQUIREMENTS.

2. Approved mockup shall represent minimum quality required for the Work.

3. Approved mockup shall remain in place within the Work.—Mock-up to be part of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site undamaged in manufacturers or sales branch's original, unopened containers and packaging, with labels clearly identifying manufacturer and product name. Include installation instructions.

B. Storage:
   1. Store materials in accordance with manufacturer's instructions.
   2. Store materials off ground and under cover.
   3. Protect materials from weather, direct sunlight, and construction activities.

C. Handling: Protect materials and finish during handling and installation to prevent damage.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers: Subject to compliance with the requirements and specifications herein available manufacturers offering products that may be incorporated into the Work included, but not limited to the following:

B. Basis of Design Product:

   1. Pella – Duracast Impervia Fiberglass Windows—Sliding Window or Fixed Window with sash in frame as denoted.
      a. Architect ensuring the compliance of all specifications and requirements approved manufacturer's based on said requirements and specifications herein Subject to strict compliance with the requirements and specifications herein: MUST BE A USA MADE PRODUCT AND COMPANY.

   2. Other Approved Manufacturer's: The following manufacturer's products meeting the requirements specified below:
      a. Marvin Fiberglass Windows
      b. Milgard Fiberglass Windows
      c. Owens Corning Fiberglass Windows
      d. Pre-approved equal

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Windows:

   1. Factory-assembled window with sash installed in frame.
   2. Frame and Sash Material: 5-layer, pultruded-fiberglass material, reinforced with interlocking mat.
   3. Foam Insulated Frame and Core and Sash for added strength and durability and energy performance.
   4. All Glazing in the Operable and Fixed Units Throughout must have "Solar Defense and/or Sun-Defense Glazing" to achieve a lower SHGC as noted below.
   5. Energy Performance for Sliding Windows: Must have window sticker to verify performance of a minimum as follows:
      a. Thermal Transmission: NFRC 100 Maximum whole-window unit U-Factor: At least .28 better.
      b. Solar Heat Gain Coefficient (SHGC): NFRC 200 Maximum whole-window unit SHGC At least .21 or better.

   6. Energy Performance for Fixed Windows: Must have window sticker to verify performance of a minimum as follows:
      a. Thermal Transmission: NFRC 100 Maximum whole-window unit U-Factor: At least .27 better.
      b. Solar Heat Gain Coefficient (SHGC): NFRC 200 Maximum whole-window unit SHGC - At least .22 or better.

B. Frame:

1. Type: Block Frame w/Clip Installation Method
2. Overall Frame Depth: 3 inches.
3. Nominal Wall Thickness of Fiberglass Members: 0.050 inch to 0.070 inch.
4. Frame Corners:
   a. Mitered.
   b. Joined and bonded with thermo-set polyurethane adhesive, nylon corner lock, and mechanically fastened.

5. Sill: Fitted with weep valve assemblies.
6. Jambs: Factory-drilled, counter-bored, installation screw holes.

C. Sash:

1. Vent Sash: Removable for cleaning exterior glass.
2. Sash Corners:
   a. Mitered.
   b. Bonded and sealed with injected thermo-set polyurethane adhesive.

D. Glazing:

1. Float Glass: ASTM C 1036, Quality 1.
   a. Tempered Glass: ASTM C 1048. On Needed units only, as required by Code.

2. Type: 11/16-inch Low-E coated with argon gas filled

E. Weather Stripping:

1. Vent Sash: Dual weather-stripped around perimeter with fin-type, dual-pile, and weather stripping.

F. Insect Screens:

1. Compliance: ASTM D 3656 and SMA 1201.
2. Screen Cloth: Half-size with black, vinyl-coated, 18/16 mesh, fiberglass screen cloth set in aluminum frame fitted to outside of window.
3. Complete with necessary hardware.
4. Screen Frame Finish: Baked enamel.
   a. Color: Brown.

2.3 HARDWARE

A. Rollers:

1. Vents: Equip with 2 nylon roller housings containing 2 acetyl rollers each.
2. Rollers: Remove for cleaning and maintenance.

B. Lock:

1. Type: Self-aligning, cam-action lock.
2. Windows 37 Inches High or Greater: 2 locks.
3. Standard Finish: Brown

2.4 TOLERANCES

A. Windows shall accommodate the following opening tolerances:

1. Horizontal Dimensions Between High and Low Points: Plus 1/4-inch, minus 0 inch.
2. Width Dimensions: Plus 1/4-inch, minus 0 inch.
3. Building Columns or Masonry Openings: Plus or minus 1/4-inch from plumb.

2.5 FINISH

A. Exterior and Interior Duracast Finish: Factory-applied powder-coat paint, comply with AAMA 613.

1. Color: Brown Duracast Fiberglass Material on Sash and Frame—Powder Coat Brown

2.6 INSTALLATION ACCESSORIES

A. Flashing/Sealant Tape and Integration:

1. Aluminum-foil-backed butyl window and door flashing tape.—on new construction, other accessories may be used on block frame installation.
2. Maximum Total Thickness: 0.013 inch.
3. UV resistant.
4. Verify sealant compatibility with sealant manufacturer.

B. Exterior Perimeter Sealant: Sealant as specified in Section 07901.

C. Insulating-Foam Sealant:

1. Low-pressure, polyurethane window and door insulating-foam sealant as recommended and approved by window manufacturer.

D. Block Frame Installation Accessories: Clip Installation MUST BE USED FOR THE INTERACTION WITH OTHER BUILDING MATERIALS, and other accessories provided by installer.

2.8 SOURCE QUALITY CONTROL

A. Factory Testing: Factory test by the manufacturer individual standard operable windows for air infiltration in accordance with ASTM E 283, to ensure compliance with this specification.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive windows. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install windows in accordance with manufacturer's instructions.

B. Install windows to be weather-tight and freely operating.

C. Maintain alignment with adjacent work.

D. Secure assembly to framed openings, plumb and square, without distortion.

E. Installation materials to be supplied by the installer for necessary completion installation as directed on the installation documents and details provided in shop drawings.

F. Place interior seal around window perimeter to maintain continuity of building thermal and air barrier using insulating foam sealant.

G. Seal window to exterior wall cladding with sealant and related backing materials at perimeter of assembly.

H. Leave windows closed and locked.

3.3 TESTING:

A. Certification prior to installation from independent certification companies—AAMA, or WDMA Acceptable certification, with Certification Sticker to be secured on each window unit delivered.

3.4 CLEANING

A. Clean window frames and glass in accordance with Division 1 requirements.

B. Do not use harsh cleaning materials or methods that would damage finish or glass.

C. Remove labels and visible markings.

3.5 PROTECTION

A. Protect installed windows to ensure that, except for normal weathering, windows will be without damage or deterioration at time of substantial completion.

END OF SECTION 08574

SECTION 08710 - DOOR HARDWARE

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 items known commercially as finish or door hardware that are required for swing doors, except special types of unique hardware specified in the same sections as the door frames on which they are installed.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 6 Section "Interior Architectural Woodwork" for cabinet hardware.
2. Division 8 Section "Standard Steel Doors and Frames" for silencers integral with hollow metal frames.

C. Products furnished but not installed under this Section include:

1. Cylinders for locks on entrance doors.
2. Final replacement cores and keys to be ordered and paid for by Contractor, shipped directly to Owner and installed by End User.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.

B. Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

C. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:

a. Type, style, function, size, and finish of each hardware item.
b. Name and manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
e. Explanation of all abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for hardware.
g. Door and frame sizes and materials.
h. Keying information.

2. Submittal Sequence: Submit final schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product

data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule.

3. Keying Schedule: Submit separate detailed schedule indicating clearly how the End User's final instructions on keying of locks has been fulfilled.

D. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single hardware supplier.

1.5 PRODUCT HANDLING

A. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

B. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).

1.6 MAINTENANCE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for End User's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Butts and Hinges:

a. Hager Hinge Co.
b. H. Soss & Company.
c. Stanley Hardware, Div. Stanley Works.
d. Mckinney
e. Or, pre-approved equal.

2. Cylinders and Locks: All locks must be compatible with Best cylinders for the final core.

a. Best Lock Corp.
b. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
c. Falcon Lock Co.
d. Sargent Manufacturing Company.
e. Schlage Lock, Div. Ingersoll-Rand Door Hardware Group.
f. Yale Security Inc.
g. Hagar
h. Hadrian Metal Lockers
i. Brad Steele & Associates

j. Or, pre-approved equal.

3. Overhead Closers:

a. Dorma Door Controls International.
b. LCN, Div. Ingersoll-Rand Door Hardware Group.
c. Monarch Hardware & Mfg. Co., Div Newman Tonks, Inc.
d. Rixson-Firemark, Div. Yale Security Inc.
e. Sargent Manufacturing Company.
f. Russwin
g. Hagar
h. Or, pre-approved equal.

4. Door Trim Units (Kickplates):

a. Baldwin Hardware Corp.
b. Builders Brass Works Corp.
c. Hager Hinge Co.
d. H. B. Ives, A Harrow Company.
e. Triangle Brass Manufacturing Company (Trimco).
f. Quality
g. Or, pre-approved equal.

5. Door Stripping and Seals:

a. Hager Hinge Co.
b. National Guard Products, Inc.
c. Pemko Manufacturing Co., Inc.
d. Reese Enterprises, Inc.
e. Zero International, Inc.
f. Ultra
g. Or, pre-approved equal.

6. Thresholds:

a. Hager Hinge Co.
b. National Guard Products, Inc.
c. Pemko Manufacturing Co., Inc.
d. Reese Enterprises, Inc.
e. Zero International, Inc.
f. Ultra
g. Or, pre-approved equal.

2.2 SCHEDULED HARDWARE

A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:

1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware type, the comparable product of one of the other manufacturers that complies with requirements.

2.3 MATERIALS AND FABRICATION

A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.

1. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. Base Metals: Produce hardware units of basic metal and forming method indicated using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.

C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

D. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

E. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.4 HINGES, BUTTS, AND PIVOTS

A. Templates: Provide only template-produced units.

B. Screws: Provide Phillips flat-head screws complying with the following requirements:

1. For metal doors and frames install machine screws into drilled and tapped holes.
2. Finish screw heads to match surface of hinges or pivots.

C. Hinge Pins: Non-removable pins.

1. Tips: Flat button and matching plug, finished to match leaves.

D. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges per door leaf for doors 90 inches or less in height and one additional hinge for each 30 inches of additional height.

2.5 LOCK CYLINDERS AND KEYING

A. Review the keying system with the Owner and provide the type required (master, grandmaster or great-grandmaster), either new or integrated with Owner's existing system.

B. Equip locks with cylinders for interchangeable-core pin tumbler inserts. Furnish only temporary inserts for the construction period, and remove these when directed. Final replacement cores and keys to be furnished by contractor and installed by End User.

1. Final Cores: Best Lock Corp..

C. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.

D. Comply with End User's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.

1. Permanently inscribe each key with number of lock that identifies cylinder manufacturer's key symbol, and notation, "DO NOT DUPLICATE."

E. Key Material: Provide keys of nickel silver only.

F. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, and 5 grandmaster keys for each grandmaster system.

1. Furnish one extra blank for each lock.
2. Deliver keys to Owner.

2.6 KEY CONTROL SYSTEM

A. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150 percent of the number of locks required for the Project.

1. Provide complete cross index system set up by key control manufacturer, and place keys on markers and hooks in the cabinet as determined by the final key schedule.

2. Provide hinged-panel type cabinet for wall mounting.

2.7 LOCKS, LATCHES, AND BOLTS

A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.

1. Provide flat lip strikes for locks with 3-piece, antifriction latchbolts as recommended by manufacturer.
2. Provide recess type top strikes for bolts locking into head frames, unless otherwise indicated.
3. Provide dust-proof strikes for foot bolts, except where special threshold construction provides nonrecessed strike for bolt.
4. Provide roller type strikes where recommended by manufacturer of the latch and lock units.

B. Lock Throw: Provide 5/8-inch minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

1. Provide 1/2-inch minimum throw of latch for other bored and preassembled types of locks and 3/4-inch minimum throw of latch for mortise locks. Provide 1-inch minimum throw for all dead bolts.

C. Exit Device Dogging: Equip the units with keyed dogging device to keep the latch bolt retracted, when engaged.

D. Rabbeted Doors: Where rabbeted door stiles are indicated, provide special rabbeted front on lock and latch units and bolts.

2.8 CLOSERS AND DOOR CONTROL DEVICES

A. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit depending on size of door, exposure to weather, and anticipated frequency of use.

1. Provide parallel arms for all overhead closers, except as otherwise indicated.
2. Provide metal enclosure plate.
3. Color & finish of all exposed surfaces to match and to be selected by Architect from manufacturers standard colors.

B. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing.

C. Provide grey resilient parts for exposed bumpers.

2.9 DOOR TRIM UNITS

A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine screws or self-tapping screws.

B. Fabricate protection plates not more than 1-1/2 inches less than door width on hinge side and not more than 1/2 inch less than door width on pull side by height indicated.

1. Metal Plates: Stainless steel, 0.050 inch (U.S. 18 gage).

2.10 WEATHERSTRIPPING AND SEALS

A. General: Provide continuous weather stripping on exterior doors. Provide noncorrosive fasteners.

B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.

C. Weather stripping at Jambs and Heads: Provide bumper-type resilient insert and metal retainer strips, surface applied unless shown as mortised or semi-mortised, and of following metal, finish, and resilient bumper material:

1. Extruded aluminum with clear anodized finish as selected from manufacturer's standard color range, 0.062-inch minimum thickness of main walls and flanges.
2. Sponge neoprene conforming to MIL R 6130, Class II (Closed Cell).
   a. Grade C (67 deg F to 170 deg F, low temperature).

D. Weather stripping at Door Bottoms: Provide threshold consisting of contact-type resilient insert and metal housing of design and size shown and of following metal, finish, and resilient seal strip:

1. Extruded aluminum with clear anodized finish as selected from manufacturer's standard color range, 0.062-inch minimum thickness of main walls and flanges.
2. Solid neoprene wiper or sweep seal complying with MIL R 6855, Class II, Grade 40.

2.11 THRESHOLDS

A. General: Except as otherwise indicated, provide standard metal threshold unit of type and profile as shown or scheduled. Width of threshold shall match width of door frame.

B. Exterior Hinged or Pivoted Doors: Provide units not less than 3 inches wide, formed to accommodate change in floor elevation where indicated, fabricated to accommodate door hardware and to fit door frames, and as follows:

1. For out-swinging doors provide thermal barrier saddle type with black rigid vinyl between extrusions.

2.12 HARDWARE FINISHES

A. Match items to the manufacturer's standard color and texture finish for the latch and lock sets (or push-pull units if no latch or lock sets).

B. Provide finishes that match those established by BHMA or, if none established, match the Architect's sample.

C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

D. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze, and aluminum, except as otherwise indicated. The suffix "-NL" is used with standard finish designations to indicate "no lacquer."

E. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.

1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.

C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Sealers."

F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.2 ADJUSTING, CLEANING, AND DEMONSTRATING

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.

1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

B. Clean adjacent surfaces soiled by hardware installation.

C. Instruct End User's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

D. Six-Month Adjustment: Approximately six months after the date of Substantial Completion, the Installer, accompanied by representatives of the manufacturers of latch sets and locksets and of door control devices, and of other major hardware suppliers, shall return to the Project to perform the following work:

1. Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.

2. Consult with and instruct End User's personnel in recommended additions to the maintenance procedures.

3. Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.

4. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.3 HARDWARE SCHEDULE

A. General: Provide hardware for each door to comply with requirements of Section "Door Hardware," hardware set numbers indicated in door schedule, and in the following schedule of hardware sets.

1. Hardware sets indicate quantity, item, manufacturer and product designation, size and finish or color, as applicable.

2. Provide hardware with US26D finish, unless indicated otherwise.

3. Lockset Designs: Provide the lockset designs designated in the Hardware Schedule or, if by another manufacturer, one that matches those designated:

4. Provide locks with interchangeable cores per requirements of this section.

3.3 Hardware Schedule: See Next Page:

HARDWARE SCHEDULE

A. Hardware Set No. 1: Door D101A, D106A, D107B & D107H

1.5 pr.	Hinges	Stanley	FBB199 4.5 x 4.5 NRP	US32D
1	Lock	Yale	AU 5407LN	US26D
1	Closer	LCN	4041	ALUM
1	Kickplate	Quality	8 x 1.5 LDW	US32D
1	Stop	Quality	119ES	US26D
1	Threshold	Pemko	169A	ALUM
1	Door Sweep	Pemko	315CN	ALUM
1 Set	Weatherstrip	Pemko	303AV	ALUM

B. Hardware Set No. 2: Door D104A & D202A.

1.5 pr.	Hinges	Stanley	FBB179 4.5 x 4.5	US26D
1	Lock	Yale	AU5407LN	US26D
1	Closer	LCN	4041	ALUM
1	Stop	Quality	307	US26D
3	Silencers			
1	Kickplate	Quality	8 x 1.5 LDW	US32D

C. Hardware Set No. 3: Door D102A.

1.5 pr.	Hinges	Stanley	FBB179 4.5 x 4.5	US26D
1	Privacy	Yale	AU5404L	US26D
1	Closer	LCN	4041	ALUM
1	Kickplate	Quality	8 x 1.5 LDW	US32D
1	Stop	Quality	307	US26D
3	Silencers			
1	Marble Threshold			

D. Hardware Set No. 4: Door D103A, D105A & D201A

1.5 pr.	Hinges	Stanley	FBB179 4.5 x 4.5	US26D
1	Lock	Yale	AU5405LN	US26D
1	Closer	LCN	4041	ALUM
1	Kickplate	Quality	8 x 1.5 LDW	US32D
1	Stop	Quality	302	US26D
1	Silencers			

E. Hardware Set No. 5: Door D107A.

2 pr.	Hinges	Hager	HD112	ALUM
1	Auto Flushbolts	Ives	FB42	US26D
1	Lockset	Yale	AU5430LN	US26D
1	Coordinator	Ives	COR x FL	ALUM
2	Closer	LCN	4041 EDA	ALUM
4	Kickplate	Quality	8 x 1.5 LDW	US32D
2	Mag Holders	LCN	SEM 7850	US26D
1	Seal	NGP	155S	ALUM
1	Astrgal	NGP	9605A	ALUM
6	Silencers			

E. Hardware Set No. 6: Door D106H.

1.5 pr.	Hinges	Hager	HD112	ALUM
1	Auto Flushbolts	Ives	FB42	US26D
1	Lockset	Yale	AU5430LN	US26D
1	Coordinator	Ives	COR x FL	ALUM
1	Closer	LCN	4041 EDA	ALUM
2	Kickplate	Quality	8 x 1.5 LDW	US32D
1	Mag Holders	LCN	SEM 7850	US26D
1	Seal	NGP	155S	ALUM
1	Astrgal	NGP	9605A	ALUM
3	Silencers			

F. Hardware Set No. 7: Door D101B, D106B, D106C, D106D, D106E, D106F, D106G, D107C, D107D, D107E, D107F, D107G, D108A, D108B, D108C & D108D

All hardware by door supplier.

END OF SECTION 08710

SECTION 09255 - GYPSUM BOARD ASSEMBLIES

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. Non-load-bearing steel framing members for gypsum board assemblies.
2. Gypsum board assemblies attached to steel framing.
3. Cementitious Backer Units

1.3 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms related to gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of product specified.

C. Product certificates signed by manufacturers of gypsum board assembly components certifying that their products comply with specified requirements.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer.

B. Single Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

C. Single Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

C. Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.7 PROJECT CONDITIONS

A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.

B. Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F (10 deg C) for 48 hours prior to application and continuously after until dry. Do not exceed 95 deg F (35 deg C) when using temporary heat sources.

C. Ventilation: Ventilate building spaces, as required, for drying joint treatment materials. Avoid drafts during hot dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Steel Framing and Furring:
   a. ClarkWestern Building Systems (Dale Industries, Inc.)
   b. Dietrich Industries, Inc.
   c. Gold Bond Building Products Div., National Gypsum Co.
   d. Or, pre-approved equal.

2. Gypsum Board:
   a. Domtar Gypsum.
   b. Georgia Pacific Corp.
   c. Gold Bond Building Products Div., National Gypsum Co.
   d. United States Gypsum Co.
   e. Or, pre-approved equal.

3. Cementitious Backer Units:
   a. United States Gypsum Co.
   b. Or, pre-approved equal.

2.2 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

A. General: Provide components of sizes indicated but not less than that required to comply with ASTM C 754 for conditions indicated.

B. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

C. Channels: Cold rolled steel, 0.05980-inch-minimum thickness of base (uncoated) metal and 7/16-inch-wide flanges, and as follows:
   1. Carrying Channels: 1-1/2 inch deep, 475 lb per 1000 feet, unless otherwise indicated.
   2. Finish: Rust inhibitive paint, unless otherwise indicated.

D. Steel Rigid Furring Channels: ASTM C 645, hat shaped, depth of 7/8 inch, and minimum thickness of base (uncoated) metal as follows:

1. Thickness: 0.0179 inch, unless otherwise indicated.

2.3 STEEL FRAMING FOR WALLS AND PARTITIONS

A. General: Provide steel framing members complying with the following requirements:
1. Component Sizes and Spacings: As indicated but not less than that required to comply with ASTM C 754 under the following maximum deflection and lateral loading conditions:
a. Maximum Deflection: L/240 at 5 lbf per sq. ft.
2. Protective Coating: G40 hot dip galvanized coating per ASTM A 525.

B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 deg and doubled over to form 3/16-inch-wide minimum lip (return) and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
1. Thickness: 0.0179 inch, unless otherwise indicated.
2. Depth: 3-5/8 inches, unless otherwise indicated.
3. Spacing: 16 inches on center, unless otherwise indicated.

C. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

2.4 GYPSUM BOARD PRODUCTS

A. General: Provide gypsum board of types indicated in maximum lengths available to minimize end to end butt joints.

B. Gypsum Wallboard: ASTM C 36 and as follows:
1. Type: Regular for vertical surfaces, unless otherwise indicated.
2. Edges: Tapered.
3. Thickness: 5/8 inch unless otherwise noted

C. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.

2.5 CEMENTITIOUS BACKER UNITS

A. Cementitious Backer Units: ANSI A118.9 and as follows:
1. Thickness: 5/8” inch

2.5 TRIM ACCESSORIES

A. Accessories for Interior Installation: Corner beads, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:
1. Material: Formed metal, plastic, or metal combined with paper, with metal complying with the following requirement:
a. Sheet steel coated with zinc by hot dip or electrolytic processes, or with aluminum or rolled zinc.
2. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:
a. Corner bead on outside corners, unless otherwise indicated.
b. LC bead with both face and back flanges; face flange formed to receive joint compound. Use LC beads for edge trim unless otherwise indicated.
c. One piece control joint formed with V shaped slot, with removable strip covering slot opening.

2.6 JOINT TREATMENT MATERIALS

A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.

B. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.

C. Setting Type Joint Compounds for Gypsum Board: Factory packaged, job mixed, chemical hardening powder products formulated for uses indicated.
   1. Where setting type joint compounds are indicated as a taping compound only or for taping and filling only, use formulation that is compatible with other joint compounds applied over it.

D. Drying Type Joint Compounds for Gypsum Board: Factory packaged vinyl based products complying with the following requirements for formulation and intended use.
   1. Ready Mixed Formulation: Factory mixed product.
   2. Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.
   3. Topping compound formulated for fill (second) and finish (third) coats.

E. Joint Tape and Joint Compound for Cement Board: Material recommended by cement board unit manufacturer

2.7 MISCELLANEOUS MATERIALS

A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.

B. Spot Grout: ASTM C 475, setting type joint compound recommended for spot grouting hollow metal door frames.

C. Steel drill screws complying with ASTM C 1002 for the following applications:
   1. Fastening gypsum board to steel members less than 0.03 inch thick.
   2. Fastening gypsum board to wood members.

D. Steel drill screws complying with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast in anchors, and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLING STEEL FRAMING, GENERAL

A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and

with ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with "Gypsum Construction Handbook" published by United States Gypsum Co.

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.
   2. Where building structure abuts ceiling perimeter or penetrates ceiling.
   3. Where partition framing and wall furring abut structure except at floor.
      a. Provide slip- or cushioned type joints as detailed to attain lateral support and avoid axial loading.

D. Do not bridge building expansion and control joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

3.3 INSTALLING STEEL FRAMING FOR SUSPENDED CEILINGS

A. Suspend ceiling hangers from building 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 supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
   3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
   4. Do not attach hangers to steel deck or deck tabs. Attach hangers to structural members.
   5. Do not connect or suspend steel framing from ducts, pipes or conduit.

B. Install suspended steel framing components in sizes and at spacings indicated but not less than that required by the referenced steel framing installation standard.
   1. Carrying Channels (Main Runners): 1-1/2 inch, 4 feet o.c.
   2. Rigid Furring Channels (Furring Members): 16 inches o.c.

C. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring members or grid suspension members are level to within 1/8 inch in 12 feet as measured both lengthwise on each member and transversely between parallel members.

3.4 INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.
   1. Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall.

B. Installation Tolerances: Install each steel framing and furring member so that fastening

surfaces do not vary more than 1/8 inch from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Cut studs 1/2 inch short of full height. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

D. Terminate partition framing at suspended ceilings where indicated.

E. Install steel studs and furring in sizes and at spacings indicated but not less than that required by the referenced steel framing installation standard to comply with maximum deflection and minimum loading requirements specified.

F. Install steel studs so that flanges point in the same direction and so that leading edges or ends of each gypsum board can be attached to open (unsupported) edges of stud flanges first.

G. Frame door openings to comply with details indicated, with GA-219, and with applicable published recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

H. Frame openings other than door openings to comply with details indicated or, if none indicated, in same manner as required for door openings. Install framing below sills of openings to match framing required above door heads.

3.5 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.

B. Install ceiling board panels across framing to minimize the number of abutting end joints and avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install wall/partition board panels to minimize the number of abutting end joints or avoid them entirely. Stagger abutting end joints not less than one framing member in alternate courses of board. At stairwells and other high walls, install panels horizontally with end abutting joints over studs and staggered.

D. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

E. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Position adjoining panels so that tapered edges abut tapered edges, and field cut edges abut field cut edges and ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions. Avoid joints at corners of framed openings where possible.

F. Attach gypsum panels to steel studs so that the leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

G. Attach gypsum panels to framing provided at openings and cutouts.

H. Spot grout hollow metal door frames. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.

I. Form control joints and expansion joints at locations indicated and as detailed, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.

J. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.).
   1. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.

K. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4-inch-to-1/2-inch-wide spaces at these locations and trim edges with U bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.

3.6 GYPSUM BOARD APPLICATION METHODS

A. Single Layer Application: Install gypsum wallboard panels as follows:
   1. On ceilings, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
   2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated, and provide panel lengths that will minimize end joints.

B. Single Layer Fastening Methods: Apply gypsum panels to supports as follows:
   1. Fasten with screws.

3.7 INSTALLING TRIM ACCESSORIES

A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.

B. Install corner beads at external corners.

C. Install edge trim where edge of gypsum panels would otherwise be exposed or semi-exposed. Provide edge trim type with face flange formed to receive joint compound except where other types are indicated.
   1. Install LC bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
   2. Install other accessories where indicated.

D. Install control joints at locations indicated, and where not indicated according to ASTM C 840, and in locations approved by Architect for visual effect.

3.8 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects, and

elsewhere as required to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated.

B. Pre-fill open joints, rounded or beveled edges, and damaged areas using setting type joint compound.

C. Apply joint tape over gypsum board joints except those with trim accessories having concealed face flanges not requiring taping to prevent cracks from developing in joint treatment at flange edges.

D. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.
   1. Level 4 for gypsum board surfaces unless otherwise indicated.

E. For level 4 gypsum board finish, embed tape in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration. Use following joint compound combination:
   1. Embedding and First Coat: Setting type joint compound or ready-mixed, drying-type, topping compound.
   2. Fill (Second) Coat: Setting type joint compound or ready-mixed, drying-type, topping compound.
   3. Finish (Third) Coat: Ready mixed, drying type, topping compound.

3.9 CLEANING AND PROTECTION

A Promptly remove any residual joint compound from adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner suitable to Installer that ensures gypsum board assemblies remain without damage or deterioration at time of Substantial Completion.

END OF SECTION 09255

SECTION 09300 - TILE

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 the following:
1. Unglazed ceramic mosaic tile.
2. Glazed wall tile.

B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 3 Section "Cast in Place Concrete" for monolithic slab finishes specified for tile substrates.
2. Division 7 Section "Joint Sealants" for tile control and expansion joints.
3. Division 9 Section “Gypsum Board Assemblies” for cement boards tile backer.

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. Shop drawings indicating tile patterns and locations and widths of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
1. Locate precisely each joint and crack in tile substrates by measuring, record measurements on shop drawings, and coordinate them with tile joint locations, in consultation with Architect.

D. 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.

E. Samples for verification purposes of each item listed below, prepared on samples of size and construction indicated, products involve color and texture variations, in sets showing 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.
3. Marble thresholds in 6-inch lengths.

F. Master grade certificates for each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

G. Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile and tile setting and grouting products with requirements indicated.

H. 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, plus other information specified.

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.

B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.

C. Maintain temperatures at 50 deg F (10 deg C) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work, include, but are not limited to, the following:
   1. Unglazed Ceramic Mosaic Tile:
      a. American Olean Tile Co., Inc.
      b. Dal-Tile Corp.
      c. Or, pre-approved equal.
   2. Glazed Wall Tile:

a. American Olean Tile Co., Inc.
b. Dal-Tile Corp.
c. Or, pre-approved equal.

3. Latex-Emulsion-Based Latex-Portland Cement Mortars:
   a. Bostik Construction Products Div.
   b. Custom Building Products
   c. Laticrete International Inc.
   d. Mapei Corp.
   e. Or, pre-approved equal.

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 full range of standard colors, textures, and patterns for products of type indicated.
   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.

2.3 TILE PRODUCTS

A. Unglazed Ceramic Mosaic Tile: Provide factory-mounted flat tile complying with the following requirements:
   1. Composition: Porcelain with abrasive admixture.
   2. Nominal Facial Dimensions: 2 inches by 2 inches.
   3. Nominal Thickness: 1/4 inch.
   4. Face: Plain with cushion edges.
   5. Aesthetic Effect: Provide tile from Dal-Tile price groups as follows, or comparable price group from other manufacturers:
      a. Price Group 1: 100 percent for field tile.

B. Glazed Wall Tile: Provide flat tile complying with the following requirements:
   1. Nominal Facial Dimensions: 4-1/4 inches by 4-1/4 inches.
   2. Nominal Thickness: 5/16 inch.
   3. Face: Plain with cushion edge, unless pattern indicated.
   4. Aesthetic Effect: Provide tile from Dal-Tile price groups as follows, or comparable price group from other manufacturers:
      a. Price Group 1: 100% for field tile.

C. Trim Units: Provide 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. Shapes: As follows, selected from manufacturer's standard shapes:
   a. Base for Portland Cement Mortar Installations: 4” Coved base of the same material as the unglazed floor tile.
   b. Wainscot Cap for Thinset Mortar Installations: Surface bullnose.
   c. External corners for Portland Cement Mortar Installations: Bullnose shape with a radius of at least 3/4 inch unless otherwise indicated.
   d. External Corners for Thinset Installations: Surface bullnose.
   e. Internal Corners: Field-butted square corners, except use coved base and cap angle pieces designed to member with stretcher shapes.

2.4 SETTING MATERIALS

A. Portland Cement Mortar Installation Materials: Provide materials complying with ANSI A108.1 and as specified below.
   1. Latex additive (water emulsion) described below, serving as replacement for part or all of gauging water, of type specifically recommended by latex additive manufacturer for use with job-mixed portland cement and aggregate mortar bed.
      a. Latex Additive: Manufacturer's standard.

B. Latex-Portland Cement Mortar: ANSI A118.4, composition as follows:
   1. Prepackaged dry mortar mix composed of portland cement, graded aggregate, and the following dry polymer additive in the form of a reemulsifiable powder to which only water is added at job site.
      a. Dry Polymer Additive: Polyvinyl acetate or ethylene vinyl acetate.

   2. Latex additive (water emulsion) of type described below, serving as replacement for part or all of gauging water, combined at job site with prepackaged dry mortar mix supplied or specified by latex additive manufacturer.
      a. Latex Type: Styrene butadiene rubber.

2.5 GROUTING MATERIALS

A. Latex-Portland Cement Grout: ANSI A118.6, color as indicated, composition as follows:
   1. Prepackaged dry grout mix composed of portland cement, graded aggregate, and the following dry polymer additive in the form of a reemulsifiable powder to which only water is added at job site.
      a. Dry Polymer Additive: Polyvinyl acetate or ethylene vinyl acetate.
   2. Latex additive (water emulsion) serving as replacement for part or all of gauging water, added at job site with dry grout mixture, with type of latex and dry grout mix as follows:
      a. Latex Type: Manufacturer's standard.
      b. Dry Grout Mixture: Commercial portland cement specified or supplied by latex additive manufacturer.
         1) Application: Use commercial portland cement grout combined with latex additive for grouting joints in floor tile unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. Floor Sealer: Penetrating silicone sealer, compatible with tile and grout.

2.7 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.

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. Lay out tile wainscots to next full tile beyond dimensions indicated.

G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw cut joints after installation of tiles.
   1. Locate joints in tile surfaces directly above joints in concrete substrates.

H. Grout tile to comply with the requirements of the following installation standards:
   1. For ceramic tile grouts (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts), comply with ANSI A108.10.

3.4 FLOOR INSTALLATION METHODS

A. Ceramic Mosaic Tile: 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. Portland Cement Mortar: ANSI A108.1
      a. 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:
         1) Latex-portland cement mortar.
      b. Concrete Subfloors, Interior: TCA F112 (bonded).
      c. Grout: Latex-portland cement.

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. Latex-Portland Cement Mortar: ANSI A108.5.
      a. Masonry, Interior: TCA W202.
      b. Grout: Latex-portland cement.

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. Apply sealer in accordance with manufacturer's recommenations. Allow grout to cure the minimum number of days recommended by the sealer 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 ensures that tile is without damage or deterioration at time of Substantial Completion.
   1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. 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 09300

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items:

C. Samples: For each exposed finish.

D. Product test reports.

E. Research/evaluation reports.

F. Maintenance data.

1.3 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.

B. Seismic Standard: Comply with the following:
1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
3. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
4. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
5. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
6. Requirement of CBC Title 24.

1.4 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. Acoustical Ceiling Panels: Full-size panels equal to [2.0] percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to [2.0] percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS, GENERAL

A. Acoustical Panel Standard: Comply with ASTM E 1264.

B. Metal Suspension System Standard: Comply with ASTM C 635.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
   1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

E. Seismic perimeter stabilizer bars, seismic struts, and seismic clips.

F. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:
   1. Armstrong World Industries, Inc.;
   2. Chicago Metallic Corporation;
   3. Ecophon CertainTeed, Inc.;
   4. USG Interiors, Inc.

C. Basis-of-Design Product: Subject to compliance with product:
   1. Armstrong Ultima with a square edge
   2. Color: White.
   3. Edge/Joint Detail: Square and reveal sized to fit flange of exposed suspension system members.
   4. Thickness: 5/8 inch (15 mm).
   5. Modular Size: 2x4
   6. Grid: 15/16” Exposed Grid

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:
   1. Armstrong World Industries, Inc.;
   2. Chicago Metallic Corporation;
   3. USG Interiors, Inc.

C. Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 15/16-inch- (24-mm-) and 9/16” (14mm).
   1. Structural Classification: Intermediate duty system.
   2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
   3. Cap Material: Steel or aluminum cold-rolled sheet.
   4. Cap Finish: Painted white.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with UBC Standard 25-2 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders.

C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

END OF SECTION 09511

SECTION 09660 - RESILIENT TILE FLOORING

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. Vinyl composition floor tile.

B. Resilient wall base, reducer strips, and other accessories installed with resilient floor tiles are specified in Division 9 Section "Resilient Wall Base and Accessories."

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 tiles showing full range of colors and patterns available for each type of resilient floor tile indicated.

D. Samples for verification purposes in full-size tiles of each different color and pattern of resilient floor tile specified, showing full range of variations expected in these characteristics.

E. Maintenance data for resilient floor tile, to include in Operating and Maintenance Manual specified in Division 1.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility for Floor Tile: Obtain each type, color, and pattern 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver tiles and installation accessories to Project site in original manufacturer's unopened cartons and containers each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

B. Store flooring materials in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).

C. Store tiles on flat surfaces.

D. Move tiles and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.

1.6 PROJECT CONDITIONS

A. Maintain a minimum temperature of 70 deg F (21 deg C) in spaces to receive tiles for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 55 deg F (13 deg C).

B. Do not install tiles until they are at the same temperature as the space where they are to be installed.

C. Close spaces to traffic during tile installation.

1.7 SEQUENCING AND SCHEDULING

A. Install tiles and accessories after other finishing operations, including painting, have been completed.

B. Do not install tiles over concrete slabs until the slabs have cured and are sufficiently dry to bond with adhesive as determined by tile manufacturer's recommended bond and moisture test.

1.8 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
   1. Furnish not less than one box for each 50 boxes or fraction thereof, of each class, wearing surface, color, pattern and size of resilient floor tile installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, resilient floor tiles that may be incorporated in the Work include, but are not limited to, the products specified in each Product Data Sheet at end of this Section.

B. Vinyl Composition Floor Tile: Products complying with ASTM F 1066, Composition 1 (nonasbestos formulated), and with requirements specified in Vinyl Composition Floor Tile Product Data Sheet at end of this Section.

2.2 INSTALLATION ACCESSORIES

A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.

B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by tile manufacturer for applications indicated.

C. Adhesives (Cements): Water-resistant type recommended by tile manufacturer to suit resilient floor tile products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Examine areas where installation of tiles will occur, with Installer present, to verify

that substrates and conditions are satisfactory for tile installation and comply with tile manufacturer's requirements and those specified in this Section.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by tile manufacturer.

2. Finishes of subfloors comply with tolerances and other requirements specified in Division 3 Section "Cast-In-Place Concrete" for slabs receiving resilient flooring.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits of any kind.

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

3.2 PREPARATION

A. General: Comply with manufacturer's installation specifications to prepare substrates indicated to receive tile.

B. Use trowelable leveling and patching compounds per tile manufacturer's directions to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

D. Broom or vacuum clean substrates to be covered by tiles immediately before tile installation. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

3.3 INSTALLATION

A. General: Comply with tile manufacturer's installation directions and other requirements indicated that are applicable to each type of tile installation included in Project.

B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths at perimeter that equal less than one-half of a tile. Install tiles square with room axis, unless otherwise indicated.

C. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

D. Where items are indicated for installing on top of finished tile floor, install tile before these items are installed.

E. Scribe, cut, and fit tiles to butt tightly to vertical surfaces, permanent fixtures, built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.

F. Extend tiles into toe spaces, door reveals, closets, and similar openings.

G. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.

H. Adhere tiles to flooring substrates without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed tile installation.

I. Use full spread of adhesive applied to substrate in compliance with tile manufacturer's directions including those for trowel notching, adhesive mixing, and adhesive open and working times.

J. Hand roll tiles where required by tile manufacturer.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing tile installation:
   1. Remove visible adhesive and other surface blemishes using cleaner recommended by tile manufacturers.
   2. Sweep or vacuum floor thoroughly.
   3. Do not wash floor until after time period recommended by resilient floor tile manufacturer.
   4. Damp-mop tile to remove black marks and soil.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by tile manufacturer.
   1. Apply protective floor polish to tile surfaces that are free from soil, visible adhesive, and surface blemishes.
      a. Use commercially available, metal, cross-linked acrylic product acceptable to tile manufacturer.
      b. Coordinate selection of floor polish with Owner's maintenance service.
   2. Cover tiles with undyed, untreated building paper until inspection for Substantial Completion.
   3. Do not move heavy and sharp objects directly over tiles. Place plywood or hardboard panels over tiles and under objects while they are being moved. Slide or roll objects over panels without moving panels.

VINYL COMPOSITION FLOOR TILE PRODUCT DATA SHEET

Vinyl Composition Floor Tile Designation: VCT Type 1.

Class:	Class 2 (through pattern tile).
Wearing Surface:	Smooth.
Thickness:	1/8 inch.
Size:	12-by-12 inches.
Color and Pattern:	As selected by product designation below.
Available Products:	"Premium Excelon - Companion Square," Armstrong World Industries, Inc.; "Collage," Tarkett Inc., Mannington VCT, or pre-approved equal.

END OF SECTION 09660

SECTION 09678 - RESILIENT WALL BASE AND ACCESSORIES

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. Resilient wall base.
2. Vinyl accessories.

B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 9 Section "Resilient Tile Flooring."

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 of manufacturer's standard sample sets in form of pieces cut from each type of product specified showing full range of colors and patterns available.

D. Samples for verification purposes in manufacturer's standard sizes, but not less than 12 inches long, of each different color and pattern of product specified.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility for Products: Obtain each type and color of product specified from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original manufacturer's unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

B. Store products in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).

C. Move products into spaces where they will be installed at least 48 hours in advance of installation.

1.6 PROJECT CONDITIONS

A. Maintain a minimum temperature of 70 deg F (21 deg C) in spaces to receive products specified in this Section for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less

than 55 deg F (13 deg C).

B. Do not install products until they are at the same temperature as that of the space where they are to be installed.

C. Close spaces to traffic during installation of products specified in this Section.

1.7 SEQUENCING AND SCHEDULING

A. Sequence installing products specified in this Section with other construction to minimize possibility of damage and soiling during remainder of construction period.

1.8 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.
   1. Furnish not less than 10 linear feet for each 500 linear feet or fraction thereof of each different type and color of resilient wall base installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, those specified in each Product Data Sheet at end of this Section.

2.2 RESILIENT WALL BASE

A. Rubber Wall Base: Products complying with FS SS-W-40, Type I, and requirements specified in the Rubber Wall Base Product Data Sheet at end of this Section.

2.3 RESILIENT ACCESSORIES

A. Vinyl Accessories: Products complying with requirements specified in Vinyl Accessory Product Data Sheet at end of this Section.

2.4 INSTALLATION ACCESSORIES

A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.

B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

C. Adhesives: Water-resistant type recommended by manufacturer to suit resilient flooring product and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where installation of products specified in this Section will occur, with Installer present, to verify that substrates and conditions are satisfactory for installation and comply

with manufacturer's requirements and those specified in this Section.

3.2 PREPARATION

A. General: Comply with manufacturer's installation specifications for preparing substrates indicated to receive products indicated.

B. Use trowelable leveling and patching compounds per manufacturers directions to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

D. Broom or vacuum clean substrates to be covered immediately before installing products specified in this Section. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

3.3 INSTALLATION

A. General: Install products specified in this Section using methods indicated according to manufacturer's installation directions.

B. Apply resilient wall base to walls, columns, pilasters, casework, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
   1. Install inside and exterior corners before installing straight pieces.

C. Place resilient accessories so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing installation:

   1. Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers of resilient product involved.
   2. Sweep or vacuum floor thoroughly.
   3. Do not wash floor until after time period recommended by manufacturer.
   4. Damp-mop resilient accessories to remove black marks and soil.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by manufacturer of resilient product involved.
   1. Apply protective floor polish to resilient accessories that are free from soil, visible adhesive, and surface blemishes.
      a. Use commercially available metal, cross-linked, acrylic product acceptable to resilient accessory manufacturer.
      b. Coordinate selection of floor polish with Owner's maintenance service.

RUBBER WALL BASE PRODUCT DATA SHEET

Style: Cove with top-set toe.

Minimum Nominal Thickness: 1/8 inch.

Height: 4 inches.

Lengths: Coils in lengths standard with manufacturer but not less than 100 feet.

Exterior Corners: Premolded.

Interior Corners: Premolded

Ends: Premolded.

Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns produced for rubber wall base complying with requirements indicated.

Available Products: Burke; Flexco Co.; Roppe Corp.; Johnsonite; or pre-approved equal.

VINYL ACCESSORY PRODUCT DATA SHEET

Product Description: Binder bar edging reducer.

Profile and Dimensions: As indicated.

Color: As selected by Architect from manufacturer's full range of colors produced for vinyl accessories complying with requirements indicated.

Available Products: "Vinyl Underslung Reducer," #168, Roppe Corp., or pre-approved equal.

END OF SECTION 09678

SECTION 09900 - PAINTING

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 surface preparation, painting, and finishing of exposed interior and exterior items and surfaces.
   1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop-priming and surface treatment specified under other Sections.

B. Paint exposed surfaces whether or not colors are designated in schedules, except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, provide custom color as selected by the Architect.
   1. Painting includes field-painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
   2. Painting includes touch-up of factory primed surfaces prior to application of finish coats.

C. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
   1. Prefinished items not to be painted include the following factory-finished components:
      a. Architectural woodwork and casework unless otherwise noted.
      b. Finished mechanical and electrical equipment.
      c. Light fixtures.
      d. Switchgear.
      e. Distribution cabinets.
      f. Concrete slab or stem walls.
   2. Concealed surfaces not to be painted include wall or ceiling surfaces in the following generally inaccessible areas:
      a. Foundation spaces.
      b. Furred areas.
      c. Pipe spaces.
      d. Duct shafts.
      e. Concrete stemwalls.
   3. Finished metal surfaces not to be painted include:
      a. Anodized aluminum.
      b. Stainless steel.
   4. Operating parts not to be painted include moving parts of operating equipment, such as the following:
      a. Valve and damper operators.
      b. Linkages.
      c. Sensing devices.
      d. Motor and fan shafts.
   5. Labels: Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 5 Section "Metal Fabrications" for shop-priming ferrous metal.
2. Division 5 Section "Metal Stairs" for shop priming ferrous metal.
3. Division 5 Section "Pipe and Tube Railings" for shop priming.
4. Division 6 Section "Interior Architectural Woodwork" for shop-priming interior architectural woodwork.
5. Division 6 Section “Miscellaneous Carpentry” for painting exposed lumber and plywood panels.
6. Division 8 Section "Standard Steel Doors and Frames" for shop-priming steel doors and frames.
7. Division 13 Section “Metal Building Systems” for shop priming metal.
8. Divisions 15 and 16: Painting mechanical and electrical work is specified in Divisions 15 and 16, respectively.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each paint system specified, including block fillers and primers.
1. Provide the manufacturer's technical information including label analysis and instructions for handling, storage, and application of each material proposed for use.
2. List each material and cross reference the specific coating, finish system, and application. Identify each material by the manufacturer's catalog number and general classification.

C. Samples for initial color selection in the form of manufacturer's color charts.
1. After color selection, the Architect will furnish color chips for surfaces to be coated.

D. Samples for Verification Purposes: Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.
1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of material and application for each coat of each sample. Label each sample as to location and application.
3. Submit samples on the following substrates for the Architect's review of color and texture only:
a. Ferrous Metal: Provide two 4-inch-square samples of flat metal and two 8-inch-long samples of solid metal for each color and finish.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance.

B. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in the 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.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage 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. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.6 JOB CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F (10 deg C) and 90 deg F (32 deg C).

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F (7 deg C) and 95 deg F (35 deg C).

C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
   1. ICI Dulux Paints (ICI).
   2. PPG Industries, Pittsburgh Paints (PPG).
   3. Pratt and Lambert (P & L).
   4. The Sherwin-Williams Company (S-W).
   5. KWAL Howells.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.

B. Material Quality: Provide the manufacturer's best-quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish the

manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: Provide custom color selections made by the Architect.

2.3 PRIMERS

A. Primers: Provide the manufacturer's recommended factory-formulated primers that are compatible with the substrate and finish coats indicated.

B. Available Products: Subject to compliance with requirements, prime coat materials that may be incorporated in the Work include, but are not limited to, the following:

1. Gypsum Drywall / Interior Plywood Primer: White, interior, latex-based primer.
   a. ICI: 1030-Ultra Hide PVA Primer Sealer.
   b. PPG: Speedhide Interior Quick-Drying Latex Sealer, 6-2.
   c. P & L: Latex Wall Primer Z30001.
   d. S-W: Pro-Mar 200 Latex Wall Primer B28W8200.

2. Ferrous Metal Primers: Synthetic, quick-drying, rust-inhibiting primers.
   a. ICI: 4160 Devguard Tank & Structural Metal Primer.
   b. PPG: Speedhide Int/Ext Rust Inhibitive Steel Primer (red), 6-208.
   c. P & L: Effecto Rust-Inhibiting Primer.
   d. S-W: Kem Kromik Metal Primer B50NZ6.

3. Ferrous Metal Primers: Alkyd-type primers.
   a. ICI: 4160 Devguard Tank & Structural Metal Primer..
   b. PPG: Speedhide Int/Ext Rust Inhibitive Steel Primer (white), 6-212.
   c. P & L: Effecto Primer Red or White.
   d. S-W: Kem Kromik Metal Primer B50WZ1.

4. Galvanized Metal Primers:
   a. ICI: 4120 All purpose Metal & Galvanized Primer.
   b. PPG: Speedhide Int/Ext Galvanized Steel Primer, 6-209.
   c. P & L: P & L Interior Trim Primer.
   d. S-W: Galvite HS B50WZ30.

2.4 UNDERCOAT MATERIALS

A. Undercoat Materials: Provide the manufacturer's recommended factory formulated undercoat materials as required in lieu of one of two finish coats that are compatible with the substrate and finish coats indicated.

B. Available Products: Subject to compliance with requirements, undercoat materials that may be incorporated in the Work include, but are not limited to, the following:

1. Interior & Exterior Enamel Undercoat: Ready-mixed enamel.
   a. ICI: 1120 Ultra Hide Alkyd Int. undercoater.
   b. PPG: SealGrip Int/Ext Alkyd Universal Primer/Sealer, 17-941NF.
   c. P & L: Interior Trim Primer.
   d. S-W: Pro-Mar 200 Alkyd Semi-Gloss Enamel B34W00251/B34W00253.

2.5 EXTERIOR FINISH PAINT MATERIAL

A. Finish Paint: Provide the manufacturer's recommended factory-formulated finish-coat

materials that are compatible with the substrate and undercoats indicated.

B. Available Products: Subject to compliance with requirements, finish coat materials that may be incorporated in the Work include, but are not limited to, the following:

1. Alkyd Gloss Enamel: Weather-resistant, air-drying, high-gloss enamel.
   a. ICI: 4308 Devguard Alkyd Industrial gloss Enamel.
   b. PPG: Speedhide Int/Ext WB Alkyd Gloss.
   c. P & L: Effecto Enamel.
   d. S-W: WB Industrial Enamel, B53 Series.

2.6 INTERIOR FINISH PAINT MATERIAL

A. Finish Paint: Provide the manufacturer's recommended factory-formulated finish-coat materials that are compatible with the substrate and undercoats indicated.

B. Available Products: Subject to compliance with requirements, finish coat materials that may be incorporated in the Work include, but are not limited to, the following:

1. Interior, Semigloss, Alkyd Enamel: Semigloss, low-odor, alkyd enamel.
   a. ICI: 1516 Ultra Hide Alkyd Semigloss Enamel.
   b. PPG: Speedhide Int/Ext Alkyd Semi-Gloss.
   c. P & L: Cellu-Tone Alkyd Satin Enamel.
   d. S-W: ProMar 200 Alkyd Semigloss Enamel, B34 Series.

2. Interior, Flat, Latex-Based Paint: Ready-mixed, latex-based paint.
   a. ICI: 1210 Ultra Hide Latex flat.
   b. PPG: Wallhide Interior Flat Latex Paint.
   c. P & L: Vapex Latex Flat Wall Finish.
   d. S-W: ProMar 200 Laytex Flat Wall Paint, B30 Series

3. Exterior, Gloss, Alkyd Enamel:
   a. ICI: 4380 Devguard Alkyd Industrial Gloss Enamel.
   b. PPG: Speedhide Int/Ext WB Alkyd Gloss.
   c. P & L: Effecto Enamel.
   d. S-W: WB Industrial Enamel, B53 Series.

2.7 DRY FOG/FALL COATINGS

A. Semi-Gloss, Latex, Dry Fog/Fall: MPI #155.

1. VOC Content: E Range of E2 (minimum).
2. Environmental Performance Rating: EPR2 (minimum).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
   1. Do not begin to apply paint until unsatisfactory conditions have been corrected.
   2. Start of painting will be construed as the 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 the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items, if necessary, to completely paint the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to the manufacturer's instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers or remove and re-prime. Notify Architect in writing about anticipated problems using the specified finish-coat material with substrates primed by others.
   2. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council (SSPC).
      a. Blast steel surfaces clean as recommended by the paint system manufacturer and according to requirements of SSPC specification SSPC-SP 6.
      b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
      c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.
   3. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Materials Preparation: Carefully mix and prepare paint materials according to manufacturer's directions.
   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 as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
   3. Use only thinners approved by the paint manufacturer and only within recommended limits.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
   1. Paint colors, surface treatments, and finishes are indicated in the schedules.
   2. Provide finish coats that are compatible with primers used.
   3. The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth even surface according to the manufacturer's directions.
   4. Apply additional coats if undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
   5. The term exposed surfaces includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
   6. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   7. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.
   8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
   9. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.
   10. Sand lightly between each succeeding enamel or varnish coat.
   11. Omit primer on metal surfaces that have been shop-primed and touch-up painted.

C. 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. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

D. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to the manufacturer's directions.
   1. Brushes: Use brushes best suited for the material applied.
   2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
   3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

E. Minimum Coating Thickness: Apply materials no thinner than the manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

F. Block Fillers: Apply block fillers to concrete at a rate to ensure complete coverage with pores filled.

G. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the 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.

H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with specified requirements.

3.4 CLEANING

A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
   1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
   1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates indicated excluding of pre-finished metal building components. Sherwin-Williams products are listed below to indicate paint system types, but are not intended to limit the choice of manufacturers.

B. Ferrous Metal: Primer is not required on shop-primed items.
   1. Full-Gloss Alkyd Enamel: Two finish coats over primer.
      a. Primer: Synthetic rust-inhibiting primer.
         1) Kem Kromik Metal Primer B50NZ6/B50WZ1.
         2) ICI: 4160 Devguard Tank & Structural Metal Primer.
      b. First and Second Coats: Gloss alkyd enamel.
         1) WB Industrial Enamel, B53 Series.
         2) ICI: 4308 Devguard Alkyd Industrial gloss Enamel.

C. Zinc-Coated Metal:
   1. High-Gloss Alkyd Enamel: Two finish coats over primer.
      a. Primer: Galvanized metal primer.
         1) Galvite HS, B50WZ30.
         2) ICI: 4120 All purpose Metal & Galvanized Primer.
      b. First and Second Coats: Gloss alkyd enamel.
         1) WB Industrial Enamel, B53 Series.
         2) ICI: 4308 Devguard Alkyd Industrial gloss Enamel.

3.7 INTERIOR PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates, as indicated. Sherwin-Williams products are listed below to indicate paint system types, but are not intended to limit the choice of manufacturers.

B. Gypsum Drywall Systems / Painted Plywood Panels:

1. Semigloss Alkyd Enamel Finish: Three coats with total dry film thickness not less than 2.5 mils.
   a. Primer: White, interior, latex-based primer.
      1) Pro-Mar 200 Latex Wall Primer B28W8200.
      2) ICI: 1030-Ultra Hide PVA Primer Sealer.
   b. First and Second Coats: Interior, semigloss, odorless, alkyd enamel.
      1) Pro-Mar 200 Alkyd Semi-Gloss Enamel, B34 Series.
      2) ICI: 1516 Ultra Hide Alkyd Semigloss Enamel.

C. Ferrous Metal:
1. Full-Gloss Enamel Finish: Two coats over primer with total dry film thickness not less than 2.5 mils.
   a. Primer: Synthetic, quick-drying, rust-inhibiting primer.
      1) Kem Kromik Metal Primer B50NZ6/B50WZ1.
      2) ICI: 4160 Devguard Tank & Structural Metal Primer.
   b. First and Second Coats: Exterior, gloss, alkyd enamel.
      1) WB Industrial Enamel, B53 Series.
      2) ICI: 4308 Devguard Alkyd Industrial gloss Enamel.

D. Zinc-Coated Metal:

1. Full-Gloss Enamel Finish: Two coats over primer with total dry film thickness not less than 2.5 mils.
   a. Primer: Galvanized metal primer.
      2) Galvite HS, B50WZ30.
      2) ICI: 4120 All purpose Metal & Galvanized Primer.
   b. First and Second Coats: Exterior, gloss, alkyd enamel.
      3) WB Industrial Enamel, B53 Series.
      2) ICI: 4308 Devguard Alkyd Industrial gloss Enamel.

E. Steel Joists, beams and decking:

1. Semi-Gloss, Latex Finish: Two coats over primer with total dry film thickness not less than 2.5 mils.

   a. Prime Coat: Alkyd anticorrosive metal primer.
   b. Topcoat: Latex dry fog/fall.

END OF SECTION 09900

SECTION 10100 - VISUAL DISPLAY BOARDS

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 visual display boards:
1. Porcelain enamel marker boards (for liquid chalk).

B. Related Sections: The following sections contain requirements that relate to this section:
1. Division 6 Section "Miscellaneous Carpentry" for wood blocking and grounds.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

B. Product Data: Include motor capacities, and individual panel weights for sliding chalkboard or markerboard units.

C. Shop Drawings: Provide shop drawings for each type of chalkboard and/or markerboard required. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

D. Samples: Provide the following samples of each product for initial selection of colors, patterns, and textures, as required, and for verification of compliance with requirements indicated.

1. Samples for initial selection of color, pattern, and texture:
a. Porcelain Enamel Markerboard: Manufacturer's color charts consisting of actual sections of porcelain enamel finish showing the full range of colors available for each type of board required.

2. Samples for verification of color, pattern, and texture selected, and compliance with requirements indicated.
a. Marker boards: Sample panels not less than 8-1/2 inches by 11 inches for each type board indicated. Include a sample panel for each color, texture, and pattern required.

1.4 QUALITY ASSURANCE

A. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of visual display boards and are based on the specific type and model indicated. Other visual display boards having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept or intended performance as judged by the Architect. The burden of proof of equality is on the proposer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
1. Porcelain Enamel Marker Boards:
a. Claridge Products and Equipment, Inc.
b. Greensteel, Inc.
c. ADP Lemco
d. Brad Steele & Associates
e. Newline
f. Or, pre-approved equal.

.2 MATERIALS

A. Porcelain Enamel Marker Boards: Provide balanced, high-pressure-laminated porcelain enamel marker boards of 3-ply construction consisting of face sheet, core material, and backing.
1. Face Sheet: Provide face sheet of 24-gage enameling grade steel especially processed for temperatures used in coating porcelain on steel. Coat the exposed face and exposed edges with a 3-coat process consisting of primer, ground coat, and color cover coat, and the concealed face with a 2-coat process consisting of primer and ground coat. Fuse cover and ground coats to steel at the manufacturer's standard firing temperatures, but not less than 1200 deg F (649 deg C).
a. Cover Coat: Provide the manufacturer's standard light-colored special writing surface with gloss finish intended for use with liquid felt-tipped markers.
2. Core: Provide the manufacturer's standard 3/8-inch-thick particleboard core material complying with the requirements of ANSI A208.1, Grade 1-M-1.
3. Backing Sheet: Provide the manufacturer's standard 0.015-inch-thick aluminum sheet backing.
4. Laminating Adhesive: Provide the manufacturer's standard moisture-resistant thermoplastic-type adhesive.

.3 ACCESSORIES

A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch-thick aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units wherever possible; keep joints to a minimum. Miter corners to a neat, hairline closure.
1. Where the size of boards or other conditions exist that require support in addition to the normal trim, provide structural supports or modify the trim as indicated or as selected by the Architect from the manufacturer's standard structural support accessories to suit the condition indicated.
2. Field-Applied Trim: Provide the manufacturer's standard screw-on trim with Phillips flat-head screws.
3. Chalk tray: Furnish the manufacturer's standard continuous, solid extrusion type aluminum chalk tray with ribbed section and smoothly curved exposed ends, for each chalkboard.

2.4 FABRICATION

A. Porcelain Enamel Marker Boards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.

B. Assembly: Provide factory-assembled marker board units, except where field-assembled

units are required.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the board, as acceptable to the Architect.
2. Provide the manufacturer's standard vertical joint system between abutting sections of marker board.

2.5 FINISHES

A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

C. Class II Clear Anodized Finish: AA-M12C22A31 (Mechanical Finish: as fabricated, non-specular; Chemical Finish: etched, medium matte; Anodic Coating: Class II Architectural, clear film thicker than 0.4 mil).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Deliver factory-built marker boards completely assembled in one piece without joints, wherever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to the Architect. When overall dimensions require delivery in separate units, pre-fit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.

B. Install units in locations and at mounting heights indicated and in accordance with the manufacturer's instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for a complete installation.

C. Coordinate job-site assembled units with grounds, trim, and accessories. Join parts with a neat, precision fit.

3.2 ADJUST AND CLEAN

A. Verify that accessories required for each unit have been properly installed and that operating units function properly.

B. Clean units in accordance with the manufacturer's instructions. Break in marker boards only as recommended by the manufacturer.

END OF SECTION 10100

SECTION 10155 - TOILET COMPARTMENTS

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. Phenolic solid core toilet compartments configured as shown on drawings.

B. Related Sections:

1. Division 9 Section "Gypsum Board Assemblies" for blocking.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of centerlines of toilet fixtures.

2. Show dimensions of required support and blocking locations.

C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for units of same thickness and material indicated for Work.

D. Product Certificates: For each type of toilet compartment, from manufacturer.

E. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PHENOLIC-CORE UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Accurate Partitions Corporation.

2. American Sanitary Partition Corporation.

3. Ampco, Inc.

4. Bobrick Washroom Equipment, Inc.

5. Bradley Corporation; Mills Partitions.

6. Knickerbocker Partition Corporation.

7. Metpar Corp.

8. Approved equal.

B. Toilet-Enclosure Style: **Floor, ceiling and wall anchored.**

C. Entrance-Screen Style: **Floor and ceiling anchored.**

D. Urinal-Screen Style: Wall hung.

E. Door, Panel, Screen, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.

F. Pilaster Shoes **at floor and ceiling**: Fabricated from stainless-steel sheet, not less than 3 inches (76 mm) high, finished to match hardware.

G. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, stainless steel.

2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

H. Phenolic-Panel Finish: Facing sheet of one color and pattern in each room. **See finish schedule for plastic laminate color.**

1. Color and Pattern: As selected by Architect from manufacturer's full range, with manufacturer's standard through-color core matching face sheet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.

b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 10155

SECTION 10425 - 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, Dimensional letters and numbers.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

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. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.

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 Plastic Laminate: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.

2. Samples for verification of color, pattern, and texture selected and compliance with requirements indicated:
a. Cast Acrylic Sheet and Plastic Laminate: Provide a sample panel not less than 8 inches by 8 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.

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. Design Concept: The Drawings indicate sizes, profiles, and dimensional requirements of signs and are based on the specific types and models indicated. Sign units by other manufacturers may be considered provided deviations in dimensions and profiles do not change the design concept as judged by the Architect. The burden of proof of equality is on the Proposer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Manufacturers of Panel Signs:

a) Allenite Signs; Allen Marking Products, Inc.
b) American Graphics Inc.
c) Andco Industries Corp.
d) APCO Graphics, Inc.
e) ASI Sign Systems, Inc.
f) Best Manufacturing Co.
g) Grimco, Inc.
h) Innerface Sign Systems, Inc.
i) Kaltech Industries Group, Inc.
j) Mills Manufacturing, Inc.
k) Mohawk Sign Systems.
l) Seton Identification Products.
m) Signature Signs, Inc.
n) Supersine Company (The).

2.2 MATERIALS

A. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg F (80 deg C), and of the following general types:

1. Transparent Sheet: Where sheet material is indicated as "clear," provide colorless sheet in matte finish, with light transmittance of 92 percent, when tested according to the requirements of ASTM D 1003.

2. White Translucent Sheet: Where sheet material is indicated as "white," provide white translucent sheet of density required to produce uniform brightness and minimum halation effects.

3. Opaque Sheet: Where sheet material is indicated as "opaque," provide colored

opaque acrylic sheet in colors and finishes as selected from the manufacturer's standards.

B. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

C. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance.

D. Colored Coatings for Acrylic Plastic Sheet: Use colored coatings, including inks and paints for copy and background colors that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are non-fading for the application intended.

2.3 PANEL SIGNS

A. Panel Signs: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.

B. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to conform with the following requirements:

1. Edge Condition: Square cut.

2. Corner Condition: Corners rounded to 3/4-inch radius unless indicated otherwise.

C. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.

D. Raised Copy: Machine-cut copy characters from matte-finished opaque acrylic sheet and chemically weld onto the acrylic sheet forming sign panel face. Produce precisely formed characters with square cut edges free from burrs and cut marks.

1. Panel Material: Matte-finished opaque acrylic sheet.

2. Raised Copy Thickness: Not less than 1/32 inch.

2.4 INFORMATION FOR SIGNS AS FOLLOWS:

A. 1. Message: "OFFICE"
2. Letter Height: 1 1/4 inches.
3. Letter Style: Helvetica.
4. Provide all ADA Compliant graphics & Braille Text

B. 1. Message: "EMP. BREAK ROOM"
2. Letter Height: 1 1/4 inches.
3. Letter Style: Helvetica.
4. 2 signs required.

C. 1. Message: "STORAGE ROOM"
2. Letter Height: 1 1/4 inches.
3. Letter Style: Helvetica.

D. 1. Message: "MECH/ELEC ROOM"
2. Letter Height: 1 1/4 inches.
3. Letter Style: Helvetica.

E. 1. Message: "GEAR OIL (90 WT)"
2. Letter Height: 1 1/4 inches.
3. Letter Style: Helvetica.

F. 1. Message: "ENGINE OIL"
2. Letter Height: 1 1/4 inches.
3. Letter Style: Helvetica.

G. 1. Message: "HYDRAULIC FLUID"
2. Letter Height: 1 1/4 inches.
3. Letter Style: Helvetica.

H. 1. Message: "TRANSMISSION FLUID"
2. Letter Height: 1 1/4 inches.
3. Letter Style: Helvetica.

I. 1. Message: "GREASE"
2. Letter Height: 1 1/4 inches.
3. Letter Style: Helvetica.

J. 1. Message: "RESTROOM"
2. Letter Height: 3/4 inches.
3. Letter Style: Helvetica.
4. Provide all ADA Compliant graphics & Braille Text

K. 1. Message: "ENTRANCE"
2. Letter Height: 3/4 inches.
3. Letter Style: Helvetica.
4. Provide all ADA Compliant graphics & Braille Text
5. 2 signs required. 1 exterior & 1 interior.

L. 1. Message: "DURING THE USE OF A TORCH OR WELDING DEVICE A FIRE EXTINGUISHER SHALL BE LOCATED NEAR THE WELDING / CUTTING OPERATION AND A "*FIRE WATCH*" PERSON SHALL OVERSEE OPERATION"
2. Letter Height: 1 1/4 inches.
3. Letter Style: Helvetica.
4. 5 signs required.

M. 1. Message: "MAXIMUM OCCUPANCY 15 PERSONS"
2. Letter Height: 3/4 inches.
3. Letter Style: Helvetica.
4. 4 signs required.

2.5 FINISHES

A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.

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. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:
   1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
   2. Silicone-Adhesive Mounting: Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended by the sign manufacturer to hold the sign in place until the adhesive has fully cured.

3.2 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION 10425

SECTION 10500 - METAL LOCKERS AND STORAGE CABINETS

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. Wardrobe lockers, including the following:
   a. Single-tier.

2. Metal storage cabinets

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 3 Section "Cast-in-Place Concrete" for concrete base.
2. Division 6 Section "Miscellaneous Carpentry" for wood furring and grounds.

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: Manufacturer's printed data including materials, accessories, construction, finishes, assembly, and installation instructions for lockers And cabinets.

C. Shop Drawings: Layout and dimensions of metal lockers and cabinets. Indicate relationship to adjoining surfaces. Show locker And cabinet elevations And details, fillers, trim, base, sloping tops, And accessories. Include locker and cabinet numbering sequence. Indicate installation and anchorage requirements.

D. Samples for Initial Color Selection: Manufacturer's color charts showing a full range of available colors.

E. Samples for Color Verification: Samples showing actual colors prepared on same material to be used for the Work.

F. Maintenance Instructions: Instructions for cleaning lockers and cabinets And for adjusting, repairing, And replacing locker And cabinet doors And latching mechanisms.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain locker And cabinet units And accessories from one manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver lockers And cabinets until spaces to receive them are clean, dry, and ready for locker And cabinet installation.

B. Protect lockers and cabinets from damage during delivery, handling, storage, and installation.

C. Deliver master keys, control keys, And combination control charts to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, manufacturers offering metal lockers and storage cabinets which may be incorporated in the ork include; but are not limited to the following:

1. The Interior Steel Equipment Co.
2. List Industries Inc.
3. Lyon Metal Products Inc.
4. Medart, Inc.
5. Penco Products.
6. Republic Storage Systems Co., Inc.
7. Hadrian Metal Lockers
8. Brad Steele & Associates

2.2 MATERIALS

A. Steel Sheet: ASTM A 366 (A 366M), commercial quality, stretcher leveled, cold rolled carbon steel sheet, stretcher leveled, free of buckling, scale, And surface imperfections.

B. Hot Dip Zinc Coated Steel Sheet: ASTM A 526/A 526M, commercial quality, zinc coated, carbon steel sheet, hot dip galvanized according to ASTM A 525 (A 525M) with A 60 (ZF 180) or G 60 (Z 180) coating designation.

C. Electrolytic Zinc Coated Steel Sheet: ASTM A 591/A 591M, with Class C zinc coating, mill phosphatized.

D. Fasteners: Zinc- or nickel plated steel; slotless type exposed bolt heads; self locking nuts or lock washers for nuts on moving parts.

E. Equipment: Manufacturer's standard plated steel hooks or coat rods.

2.3 WARDROBE LOCKERS

A. Arrangement: Single-tier.

B. Size: 72 inches high by 15 inches wide by 18 inches deep.

C. Body: Form backs, tops, bottoms, sides, And intermediate partitions of flanged 0.0239-inch (24 ga) (0.61-mm) minimum steel sheet.

1. Form exposed ends of non recessed lockers of 0.0598-inch (16 ga) (1.5-mm) minimum steel sheet.

D. Frames: Form channel frames of 0.0598-inch (16 ga) (1.5-mm) minimum steel sheet. Form continuous integral strike on vertical frame members or weld 0.0897-inch (13 ga) (2.3-mm) minimum latch hooks to latch strike frame.

1. Cross Frames: Form intermediate channel cross frames to double- or triple tier lockers of 0.0598-inch (16 ga) (1.5-mm) minimum steel sheet.

E. Shelf: Form 0.0239-inch (24 ga) (0.61-mm) minimum steel sheet hat shelf in single tier units.

F. Door: One piece steel sheet, flanged at all edges, constructed to prevent springing when opening or closing. Fabricate to swing 180 degrees.
   1. Thickness: 0.0598 inch (16 ga) (1.5 mm) minimum.
   2. Style: Louvered vents.

G. Reinforcing ~~**Sound-Dampening**~~ Panels: Brace or reinforce inner face of doors with manufacturer's standard reinforcing angles, channels, or stiffener panels.

H. Acoustical Treatment: Fabricate lockers for quiet operation with manufacturer's standard rattle free latching mechanism with moving components isolated to prevent metal-to-metal contact.

I. Louvered Vents: Stamped, louvered vents in door face, as follows:
   1. Single Tier Lockers: No fewer than 6 louver openings top and bottom.

J. Security Vents: Manufacturer's standard arrangement of stamped horizontal or vertical security vents on door face.

K. Hinges: Steel, full loop, 5- or 7-knuckle tight pin, 2 inches (51 mm) high minimum. Weld to inside of frame and secure to door with not fewer than 2 factory installed fasteners that are completely concealed and tamperproof when door is closed.
   1. Provide at least 3 hinges for each door over 42 inches (1067 mm) high; at least 2 hinges for each door 42 inches (1067 mm) high or less.

L. Recessed Housing for Latch: Manufacturers' standard housing to form recess for latch lifter locking devices; non-protruding latch lifter containing strike eye for padlock; automatic, pre-locking, pry resistant latch mechanism with latching action as follows:
   1. Single-Tier Lockers: Not less than 3-point latching.

2.4 METAL STORAGE CABINETS

A. Size: 78 inches high by 36 inches wide by 18 inches deep.

B. Shelving: 4 shelves adjustable every 2 inches

C. Storage: Minimum 180 lbs. per shelf storage requirement

D. Finish: All surfaces to receive manufacturer’s stock finish

2.4 LOCKS

A. Fabricate lockers to receive the following locking devices:

   1. Combination padlock.

B. Fabricate cabinets to receive the following locking devices:

   1. Built-in key lock

2.5 LOCKER ACCESSORIES

A. Equipment: Furnish each locker with:

1. 2 single prong wall hooks.
2. Coat Rod.

B. Number Plates: Manufacturer's standard etched, embossed, or stamped, nonferrous metal number plates with numerals not less than 3/8 inch (9 mm) high. Number lockers in sequence indicated. Attach plates to each locker door, near top, centered, with at least 2 fasteners of same finish as number plate.

C. Recess Trim: Manufacturer's standard 0.0478-inch (18 ga) (1.2-mm) minimum steel sheet trim with concealed fastening clips.

D. Filler Panels: 0.0478-inch (18 ga) (1.2-mm) minimum steel sheet, factory fabricated.

E. Folding Bench, complying with:

1. Operation: Seat is automatically held in a raised position by a stainless cross member attached to the front and rear support legs. When seat is lowered into the down position, the swing down leg automatically aligns the front and rear support legs with the help of the stainless cross member.
2. Frame: Type 304 (18-8) stainless steel tube, 1-1/4” (32 mm) x 18ga. (1.2mm) sq. mainframe with 1” (25mm) x 18ga. (1.2mm) rd. cross members.
3. Wall Flanges (2 minimum): Type 304 (18-8) stainless steel 10ga. (3.4mm) x 3” (76mm) diameter, Heliarc welded to 1” (25mm) rd. x 18ga. (1.2mm) 90 degree leg supports, and to 1-1/4” (32mm) rd. x 12ga. (1.7mm) frame hinge couplings. Three mounting holes in each flange.
4. Leg: “H”-shaped yoke of type 304 (18-8) stainless steel. 1” diameter (25mm) x 18ga. (1.2mm) round, Heliarc welded to 1-1/4” (32mm) rd. x 12ga. (2.7mm) frame hinge couplings.
5. Seat: White finish on 1/2" Phenolic, bolted to frame with SS screws.

2.6 FABRICATION

A. Fabricate lockers square, rigid, without warp, with metal faces flat, free of dents or distortion. Make exposed metal edges free of sharp edges, burrs, safe to touch. Weld frame members together to form a rigid, 1-piece structure.

1. Form locker body panels, doors, shelves and accessories from 1-piece steel sheet unless otherwise indicated.
2. Preassemble lockers by welding all joints, seams, connections. Grind exposed welds flush.

2.7 FINISHES, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying And designating finishes.

B. Finish all steel surfaces, accessories, except prefinished stainless steel or chrome plated surfaces.

C. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering prior to shipment.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within 1/2 of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and they are assembled or

installed to minimize contrast.

2.8 GALVANIZED-STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces of dirt, grease, other contaminants followed by a conversion coating of type suited to organic coating applied over it. Clean welds, mechanical connections, abraded areas follow with an application of the galvanizing repair paint, specified below, to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

B. Baked Enamel Finish: Immediately after cleaning/pretreating, apply manufacturer's standard baked enamel finish consisting of a thermosetting topcoat. Comply with paint manufacturer's instructions for application and baking to achieve a minimum dry film thickness of 1.1 mils (0.028 mm) on doors, frames, legs, and 0.7 mil (0.018 mm) elsewhere.

1. Color and Gloss: As selected by Architect from manufacturer's standard choices for color and gloss.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install metal lockers and cabinets complete with accessories according to manufacturer's recommendations. Install plumb, level, rigid, and flush.

B. Connect together welded locker and cabinet groups with standard fasteners according to manufacturer's recommendations, with no exposed fasteners on face frames.

C. Anchor lockers and cabinets to floors and walls at intervals recommended by manufacturer but no greater than 36 inches (910 mm). Install anchors through back-up reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.

D. Install recess trim to recessed lockers using concealed fasteners. Provide hairline joints and concealed splice plates.

E. All Dressing Benches must only be installed using suitable fasteners and sufficient in-wall backing materials. ADA mounting height for seat in lowered position is 17” (432mm) to 19” (482mm).

3.2 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.

B. Clean interior and exposed exterior surfaces and polish stainless steel and nonferrous metal surfaces.

C. Protect lockers and cabinets from damage, abuse, dust, dirt, stain, or paint. Do not permit locker use during construction.

D. Touch up marred finishes, or replace locker and cabinet units that cannot be restored to factory finished appearance. Use only materials And procedures recommended or furnished by locker and cabinet manufacturer.

END OF SECTION 10500

SECTION 10522 - FIRE EXTINGUISHERS AND ACCESSORIES

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. Fire extinguishers.
2. Fire extinguisher mounting brackets.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. J.L. Industries.
2. Larsen's Manufacturing Co.
3. Potter-Roemer, Inc.
4. Or, pre-approved equal.

2.2 FIRE EXTINGUISHERS

A. General: Provide fire extinguishers for each location 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 4-A:80-B:C, 18-lb nominal capacity, in enameled steel container.

2.3 MOUNTING BRACKETS

A. Brackets: Designed to prevent accidentally dislodging extinguisher, of sizes required for type and capacity of extinguisher indicated, with red enamel finish.
1. Provide brackets for extinguishers not located in cabinets.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Follow manufacturer's printed instructions for installation.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights to comply with applicable regulations of governing authorities.

END OF SECTION 10522

SECTION 10800 - TOILET AND BATH ACCESSORIES

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 toilet and bath accessory items as indicated on drawings.

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.

B. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.

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.

1.6 WARRANTY

A. Warranty: Submit a written warranty executed by mirror manufacturer, agreeing to replace any mirrors that develop visible silver spoilage defects within warranty period.

B. Warranty Period: 15 years from date of Substantial Completion.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering toilet accessories that may be incorporated in the Work include, but are not limited to, the following:

1. Bobrick Washroom Equipment, Inc.
2. Bradley Corporation.
3. American Specialties Inc.
4. Gamco

2.2 MATERIALS, GENERAL

A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 0.034-inch (22-gage) minimum thickness.

B. Mirror Glass: Nominal 6.0-mm (0.23-inch) thick, conforming to ASTM C 1036, Type I, Class 1, Quality q2, and with silvering, electro-plated copper coating, and protective organic coating.

C. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.3 COMBINATION TOWEL DISPENSER/WASTE RECEPTACLE UNITS

A. Recessed Unit: Stainless steel combination unit fabricated for nominal 4-inch wall depth with continuous, seamless wall flange. Towel compartment in upper portion of unit designed to dispense not less than 400 C-fold or 700 multifold paper towels. Waste receptacle in lower portion of unit provided with reusable, heavy-duty vinyl liner, minimum 4-gallon capacity. Provide flush doors with piano hinges and tumbler locks on upper and lower compartments.

2.4 COMBINATION TOILET TISSUE DISPENSER/SANITARY NAPKIN DISPOSAL UNITS

A. Recessed Unit: Fabricate of stainless steel with satin finish for recessed mounting in nominal 4-inch wall depth. Provide complete with drywall mounting clamp. Clearance between grab bar and unit required.

1. Size: Unit to accommodate two separate core-type tissue rolls up to 5 inches in diameter.

2.5 GRAB BARS

A. Stainless Steel Type: Provide grab bars with wall thickness not less than 0.05 inch (18 gage) and as follows:

1. Mounting: Concealed, manufacturer's standard flanges and anchorages.
2. Clearance: 1-1/2-inch clearance between wall surface and inside face of bar.
3. Gripping Surfaces: Manufacturer's standard nonslip texture.
4. Heavy-Duty Size: Outside diameter of 1-1/2 inches.

2.6 SOAP DISPENSERS

A. Liquid Soap Dispenser, Horizontal-Tank Type: Fabricate for surface mounting, sized for 40-fluid-ounce minimum capacity. Provide stainless steel piston, springs, and internal parts designed to dispense soap in measured quantity by pump action. Provide cover of type 304 stainless steel in No. 4 finish, with unbreakable window-type refill indicator.

1. Equip unit with push-type valve for dispensing soap in liquid form.

2.7 MISCELLANEOUS ACCESSORIES

A. Mop and Broom Holder: 0.05-inch (18-gage), Type 304, stainless steel hat channel with spring-loaded, rubber, cam-type mop/broom holders. Provide unit 24 inches long and complete with three holders.

B. Double-Prong Robe Hook: Heavy-duty satin finished stainless steel double-prong robe hook; rectangular wall bracket with backplate for concealed mounting.

2.8 MIRROR UNITS

A. Standard Stainless Steel Framed Mirror Units: Fabricate frame with channel shapes not less than 0.04 inch (20 gage), with square corners carefully mitered to hairline joints and mechanically interlocked. Provide in Type 430 bright polished finish.

2.9 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 full-length, stainless steel piano hinge. Provide anchorage that is fully concealed when unit is 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 (22 gage) 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 theftproof 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, re-supply, etc. 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 446.

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.

3.3 SCHEDULE OF ACCESSORIES

A. Manufacturer: The following catalog numbers refer to products of Bobrick Washroom Equipment, Inc. and these scheduled products serve as the standard of quality required for the project. Provide these or comparable products from specified manufacturers if they meet or exceed this standard of quality.
   1. Semi-Recessed Paper Towel Dispenser and Waste Receptacle: #B-3944.
   2. Paper Towel Dispenser: #B-262.
   3. Toilet Tissue Dispenser & Sanitary Napkin Disposal: #B-3094.
   4. Grab Bars: #B-6806.99, #B-68616
   5. Soap Dispenser: #B-2112.
   6. Mop & Broom Holder: #B-223 x 24".
   7. Robe Hook: #B-682.
   8. Mirror: #B-166 2436

END OF SECTION 10800

SECTION 11999 - CIRCULATION FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. High volume, low speed (HVLS) ceiling fans.

1.2 RELATED SECTIONS

A. Section 16050 - Basic Electrical Methods and Materials.

1.3 REFERENCES

A. American National Standards Institute/Air Movement and Control Association (ANSI/AMCA) Standard 230 - Laboratory methods for testing air circulating fans for rating.

B. National Fire Protection Agency (NFPA) 13 - National fire code for sprinklers.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Providing sole source for design, engineering, manufacturing and warranty claims.

B. Installer Qualifications: Trained by manufacturer or manufacturer certified installation (documentation required).

1.6 DELIVERY, STORAGE AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 COORDINATION

A. The fan shall be capable of receiving a stop command from the fire panel, a VESDA, or any number of smoke, flame or heat detectors.

B. The fans shall be as follows:

1. The fan shall meet the requirements of NFPA 13 (National Fire for Sprinklers) in regards to blocking obstructions below sprinkler heads.
2. The fan shall meet the air velocity requirements of FM Global's 2.0 data sheet for ESFR sprinklers.
3. If required by the local fire prevention authority, the fans shall be tied into the building's fire suppression system so that the fans shut off as soon as a fire is detected. The fan's control box shall include a variable frequency drive that facilitates this. The low voltage wire and relay needed to accomplish this shall be supplied by the Fire Alarm installer.
4. When the fan is shut off upon fire detection as described above, the fan shall come to a complete stop in less than 45 seconds.

1.9 WARRANTY

A. Minimum warranty requirements: 10-year parts; 1-year labor; 10-year structural; Lifetime on workmanship of blades and hub; 1-year money-back customer satisfaction guarantee.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Delta T Corporation, dba Big Ass Fans, PO Box 11307, Lexington, Kentucky 40575. Phone (877) 244-3267. Fax (859) 233-0139. Website: www.bigassfans.com.

2. Rite-Hite Corp., 8900 North Arbon Drive, Milwaukee, WI 53223. Phone: 1-888-214-0882. Website: www.ritehite.com or www.ritehitefans.com.

3. 4Front Engineered Solutions - Kelley/Serco, 1612 Hulton Drive, Suite 140, Carrollton, TX 75006. Phone: (972) 466-0707. Website: www.kelleycompany.com or www.sercocompany.com.

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered if submitted before bidding and in accordance with provisions of Section 01600.

2.2 HIGH VOLUME, LOW SPEED FANS

A. Basis of Design:
1. Powerfoil X as manufactured by Big Ass Fans.
2. Revolution HVLS Fan as manufactured by Rite-Hite Fans.

B. Size: minimum 8 foot diameter to maximum 12 foot diameter, or as indicated on the drawings.

C. Airfoil / Blade Material: Aluminum.

D. Airfoil / Blade Finish: Provide powder coated airfoils/blades, color as selected by the architect from a full range of colors including custom colors.

E. Motor: minimum 1.0 HP and shall be an AC induction type inverter. The motor shall be totally enclosed, fan cooled (TEFC) with an IP55 NEMA classification. NEMA standard frames 56C/143TC/145TC shall be provided for ease of service. The motor shall be manufactured with a double baked Class F insulation and be capable of continuous operation in -30°F to 122°F ambient conditions.

F. Electrical Requirements: Electrical consumption of the fans shall not exceed 185 W in destratification mode. Provide electrical rough-in to within 3 feet of the fan motor.

G. Decibels: Not to exceed 55 dBA (measured 20' below blades and 20' horizontally from the center of the fan).

H. Air Speed/Movement: The HVLS fan shall provide a minimum of 2 air turnovers per hour while generating an air speed at the occupant level (67" above finished floor) that does not exceed 50 feet per minute in destratification mode.

I. Mounting Height and Required Clearances: per manufacturer requirements and as indicated on the drawings.

J. Safety Cable: The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be 3/8" diameter and fabricated out of 7 x 19 stranded galvanized steel. The loops shall be secured with swaged Nicopress fittings, pre-loaded and tested to 3,000 lb·ft.
   1. Field construction of safety cables is not permitted.

K. Controller: The fan controller shall be constructed using a Variable Speed Drive (VSD) that is pre-wired to the motor and factory programmed to minimize the starting and braking torques, for smooth and efficient operation. The controller shall be prewired to the motor using a short fun of flexible conduit THHM with a dedicated ground conductor to minimize electromagnetic interference (EMI) and radio frequency interference (RFI). An incoming power cord shall also be pre-wired to the controller for ease of installation. The controller shall be contained within a completely sealed aluminum enclosure and secured to the mounting post 'onboard' the fan assembly.

L. Wall Control: The fan shall be equipped with a remote wall control. The wall control shall be a digital keypad device mounted inside an aluminum bezel. The bezel shall be capable of mounting to a standard wall box. The wall control shall be equipped with touchpad controls and an LED display for controlling the fan's direction, operation and speed. Communication with the fan drive and controller shall be by a standard commercially available CAT-5 (or higher) Ethernet cable that is field installed and provided by the installer. A 5' (1.5 m) 'patch cable' shall be provided to test and verify communication signals locally prior to connecting the remote connection cable.
   1. The wall control shall be equipped with a simple diagnostic program to identify faults in the system. Provisions must be made for retrieving fan operation and diagnostic data (fault messages) through the remote wall device.

M. Finishes/Colors: Provide powder coated color selected by architect from a full range of colors, including custom colors: Airfoils/Blades, Hub, Mounting System, Mounting Post (where installed). Provide color selected by architect from a full range of colors, including custom colors: Winglets (where installed).

N. Complete Unit: The fan shall be ETL certified and built pursuant to construction guidelines set forth by UL standard 507 and CSA standard 22.2.

O. Warranty: The manufacturer shall replace any products or components defective in material or workmanship, free of charge to the customer (including transportation charges within the USA, F.O.B. construction site), pursuant to the complete terms and conditions of the manufacturer. Provider manufacturer's warranty: 10-year parts; 1-year labor; 10-year structural; Lifetime on workmanship of blades and hub; 1-year money-back customer satisfaction guarantee.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The fan shall be mounted to an angle iron or I-beam structure. Consult the manufacturer's installation requirements or Installation Guide for proper sizing and placement of angle iron for a span mount. A structural engineer must be consulted for installation methods outside the manufacturer's recommendation and a certification submitted prior to installation.

B. To reduce the risk of injury to persons, the fan shall be installed so that the airfoils are at least 10' above the floor. The fan installation area must be free of obstructions such as lights, cables, sprinklers or other building structures; with the airfoils at least 2' clear of all obstructions. Contractor to coordinate with radiant tube heating system so that fan blades do not interfere with radiant tube heating supports. The fan should not be installed where it will be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems.

C. If the fan is hung from an extension tube that measures 4' or longer, it may be necessary to provide guy cables or struts to limit potential lateral movement of the fan. A stiffening strut braced against an additional beam may be required if there is a close clearance situation.

D. The design criteria for the fan mounting system shall be capable of handling 300 ft·lbs of torque.

3.2 WORKMANSHIP

A. Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.

3.3 DOCUMENTATION

A. The manufacturer shall furnish a copy of all operating and maintenance instructions for the fan.

END OF SECTION

SECTION 12511 - HORIZONTAL LOUVER BLINDS

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 horizontal louver blinds.

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 horizontal louver blind specified. Include printed data on physical characteristics.

C. Samples for initial selection purposes in manufacturer's standard sizes showing full range of colors available for each type of blind indicated.

D. Maintenance data to include in Operating and Maintenance Manual specified in Division 1.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has specialized in installing horizontal louver blinds similar to those required for this Project.

B. Surface Burning Characteristics: Provide blinds identical to those tested for the following fire performance characteristics as determined by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Test Method: NFPA 701, Small Scale Vertical Burn Test.

C. Single-Source Responsibility: Obtain horizontal louver blinds from one source of a single manufacturer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Check openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, horizontal louver blinds that may be incorporated in the Work include, but are not limited to, the products specified in each Horizontal Louver Blind Product Data Sheet at the end of this Section.

2.2 MATERIALS AND FABRICATION

A. Product Standard and Description: American Window Covering Manufacturers Association (AWCMA) Document 1029. Each horizontal louver blind unit consists of slats, rails, cord lock, tilting mechanism, tapes, and installation hardware complying with referenced product standard and requirements indicated on each Horizontal Louver Blind Product Data Sheet at the end of this Section.

B. Lifting and Tilting Mechanisms: Noncorrosive, self-lubricating materials.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
   1. Blind Units Installed Between (Inside) Jambs: Width and length equal to 1/2 inch less than opening dimensions formed by jamb, head, and sill members of opening in which each blind is installed.

D. Installation Fasteners: Not less than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction and to support blind units under conditions of normal use.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings where horizontal louver blinds will be installed prior to beginning installation. Verify that critical dimensions are correct and surface conditions acceptable.
   1. Complete all finishing operations, including painting, before beginning installation.

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

3.2 INSTALLATION

A. Install blinds level, plumb, and located so exterior slat edges in any position are not closer than 1 inch to interior face of glass lites, gaps between slat ends and jambs do not exceed 1/4 inch plus or minus 1/8 inch, and bottom rail in fully lowered position is within 1/2 inch of bottom of window or other opening.

3.3 CLEANING

A. After completing the installation, clean blind surfaces according to the manufacturer's instructions.

B. Remove surplus materials, packaging, rubbish and debris resulting from the installation. Leave areas where installation occurred neat, clean, and ready for use.

HORIZONTAL LOUVER BLIND PRODUCT DATA SHEET

Slat Description: Perforated slats complying with the following requirements:

Openness Factor: 180 degrees

Nominal Slat Width: 1 inch (mini blinds.)

Tilt Operation: Manual with wand.

Position of Tilter Control: Left side unless otherwise indicated.

Tilt: Full.

Cord Lock Operation: Cord lock, locks pull cord to stop blind at any position in ascending or descending travel.

Position: Right unless otherwise indicated.

Cord Equalizers: Self-aligning to maintain horizontal blind position.

Valance: Match color of slats.

Mounting: Wall.

Color: As selected by Architect from manufacturer's full range of colors produced for horizontal blinds specified.

Product(s): As follows:

"Bali Classic Mini" - Carey-McFall

"Riveria" – Levolor

Or pre-approved equal.

END OF SECTION 12511

SECTION 14620 - MONORAIL TROLLEY HOISTS

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 the complete monorail trolley hoist system, including monorail beam and bracing, trolley, hoist, all appurtenances, and installation.

B. Related Sections:
1. Division 5 Section “Metal Fabrications” for fabrications and erection requirements for monorail beam and bracing.
2. Division 16 Electrical.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data for each trolley hoist unit, indicating capacities, sizes, performances, operations, safety features, controls, finishes, and similar information. Indicate any variations from specified requirements.

C. Shop Drawings including dimensioned drawings showing plans, elevations, sections and large-scale details showing monorail beams, trolley, monorail beam bracing, hoist and all appurtenances.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage the hoist manufacturer or an installer approved by the manufacturer and who has completed crane and hoist installations similar in material, design, and extent to that indicated for Projects which have resulted in installations with a record of successful in-service performance

B. Regulatory Requirements: Comply with local governing regulations and the requirements of OSHA, the standards of the Crane Manufacturer's Association of America (CMAA), and the Hoist Manufacturer's Institute (HMI).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering trolley hoists that may be incorporated in the Work include but are not limited to the following:

1. Five ton motorized trolley hoist:

a. ACCO Hoists
b. R & M Material Handling – SX Series Hoists
c. Yale Hoists - EW

2.2 MATERIALS AND COMPONENTS

A. Five ton motorized trolley hoist:

1. Trolley: Adjustable for 6-inch to 18-inch flange width.

   a. Wheels: Cast iron with sealed, lifetime lubricated ball bearings.
   b. Provide sideplates with heavy-duty bumpers to protect wheels.
   c. Capacities: 5 tons
   d. Operation: motorized
   e. Motor: 1/3 hp min.
   f. Speed: 45 fpm min.
   g. Provide hoist rail seismic bracing per 2009 IBC

2. Hoist: electric wire rope operation.

   a. Configuration: Single reeved, low headroom wire rope
   b. Brakes: Provide a dc rectified magnetic disc motor brake rated at 250% of motor torque. In addition, provide regenerative control braking.
   c. Motor: 5 hp min. 30 min, Class “F”, TENV or TEFC motors
   d. Speed: 20 fpm min. Single or two speed
   f. H4 duty rating
   g. Provide an overload limit switch set at 115% of rated capacity.
   h. Upper and lower limit switches
   il. NEMA 3R control enclosure
   j. Helical-spur gear train
   k. Cast alloy gear case
   l. Metallic sheaves
   m. Vertical lift: 18'-0" feet min. Coordinate with plans.

   3. Hoist Beam: ASTM A-992. Hoist manufacturer shall size the beams using acceptable engineering practices. Provide beam calculations stamped by a Utah Professional Engineer. Provide straight beams with minimal sweep. Orient the beams so that the natural camber will be up. Provide proper splices that will not interfere with the operation of the trolley hoist. Weld the tread line at each splice and grind smooth to provide an even transition without a “bump”. Monorail hangers will be sized to meet the requirements of the trolley hoist capacity and duty cycle. All-thread rod will not be allowed. Beams shall be braced to prevent lateral movement due to trolley loads.

4. Electrification: Provide rolled galvanized insulated steel conductor system. 4 conductor (3 phase, 1 ground) mounted 2 on each side of monorail for bottom contact. Provide conductor hangers and all necessary hardware required for installation and operation of complete system (See plans for length).

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's instructions and recommendations for work during installation.

B. Provide permanent / removable stops on the beam to prevent trolley overrun.

C. Provide final electrical connection from junction box adjacent to monorail to conductor system (See plans for length).

3.2 LOAD TEST

A. Upon completion of the installation, installer will provide a 125% of capacity load test of the equipment using test weights provided by the installer. The load test will comply with OSHA and a certificate of satisfactory completion will be issued by the installer.

END OF SECTION 14620

SECTION 15010 - GENERAL REQUIRMENTS

PART 1 - GENERAL

1.1 GENERAL

A. General Conditions and Division 01 apply to this Division.

1.2 SCOPE

A. Includes -

1. Furnish all labor, materials, and equipment necessary for the completion of the mechanical and plumbing scope of work.
2. Furnish and install all motors specified in this Division and be responsible for the proper operation of electrical powered equipment furnished by this Division.
3. Furnish exact location of electrical connections and information on motor controls to Division 16.
4. Mechanical Contractor shall obtain the services of independent Test and Balance Agency.
5. Placing the air conditioning, heating, ventilating, and exhaust systems into full operation and continuing their operation during each working day of testing and balancing.
6. Making changes in pulleys, belts, and dampers, or adding dampers, as required for the correct balance as recommended by Balancing Contractor at no additional cost to Owner.
7. Air balance, final adjustment and test run.
8. The satisfactory performance of the completed systems is a requirement of this specification.

B. Related Work Specified Elsewhere

1. Conduit, line voltage wiring, outlets, and disconnect switches specified in Division 16.
2. Magnetic starters and thermal protective devices (heaters) not a factory mounted integral part of packaged equipment are specified in Division 16.

1.3 SITE OBSERVATION

A. The Contractor shall examine the site and understand the conditions which may affect the performance of work of this Division before submitting proposals for this work.

B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

1.4 COORDINATION OF WORK:

A. Coordinate work of various trades in installing interrelated work. Before installation of mechanical items, make proper provision to avoid interferences in a manner approved by

Engineer. Changes required in work specified in Division 15 caused by neglect to secure approval shall be made at no cost to Owner.

B. Arrange piping, ductwork, and equipment to permit ready access to valves, unions, starters, motors, control components, and to clear openings of doors and access panels. Contractor shall provide all necessary access doors and/or panels to provide complete access to all mechanical equipment, dampers, or accessories. Doors for dampers, etc. shall be minimum 12" x 12" and doors for mechanical equipment shall be minimum 24" x 24".

C. Furnish and install inserts and supports required by Division 15 unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions involved in sufficient time to be built into the construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by Contractor.

D. Be responsible for required digging, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Owner and Architect. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.

1. Patch and repair walls, floors and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
2. This Division shall bear expense of cutting, patching, repairing, and replacing of work of other Divisions because of its fault, error, tardiness, or because of damage done by it.
3. Provide the necessary cutting, patching, repairing, and replacing pavements, sidewalks, etc. to permit installation of work of this Division.

E. Adjust locations of piping, ductwork, equipment, etc, to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and cut prior to fabrication.

1. Make offsets, transitions, and changes in direction of piping, ductwork, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.

F. Slots and openings through floors, walls and roofs shall be provided by this Division.

G. This Contractor shall schedule his work, store his equipment and materials, and work in harmony with other Contractors so as to not delay or jeopardize the construction.

H. This Division shall coordinate with electrical contractor to insure that all required components of control work are included and fully understood. Any discrepancies shall be called to the attention of the Engineer before completion of bids. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.5 EQUIPMENT & MATERIALS:

A. Requests for substitution shall be received in writing a minimum of seven days prior to bidding. Prior acceptance shall be by Manufacturer's name only. Items not listed in this specification or subsequent addendums shall not be considered. No oral approvals will be acceptable. Manufacturers listed in this specification are acceptable only for items listed. All other items manufacturer wishes to bid must be prior approved. All equipment shall be subject to final review in accordance with "Project Submittals".

B. Product Approvals -

1. If approval is received to use other than specified items, responsibility for specified capacities and insuring that items to be furnished will fit space available lies with this Division.

2. In the event other than specified equipment is used and will not fit job site conditions, this Division assumes responsibility for replacement with items named in Specification.

C. Use domestic made pipe, pipe fittings, and motors on Project.

D. Motor and equipment name plates as well as applicable UL labels shall be in place when Project is turned over to Owner.

E. Insure that items to be furnished fit spaces available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. Do not scale off drawings.

F. All materials shall be of the best commercial quality obtainable, consistent with specified materials and for the purpose or function intended. Materials shall be new unless specifically excepted.

G. Equipment catalog or model numbers shown define the basic equipment types and quality standard only. Catalog numbers shall not be considered as all inclusive and shall be verified to include all devices, controls, operators, and appurtenances necessary for the satisfactory and complete operation of the equipment.

H. Follow manufacturer's directions in delivery, storage, protection, and installation of equipment and materials.

1. Promptly notify Engineer in writing of conflicts between requirements of Contract Documents and Manufacturer's directions and obtain Engineer’s written instructions before proceeding with work. Contractor shall bear all expenses arising from correcting deficiencies of work that does not comply with Manufacturer's directions or such written instructions.

I. Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in a dry, heated space.

1.6 PROJECT SUBMITTALS:

A. Furnish complete catalog data for manufactured items of equipment to be used in the Work to for review within 15 days after award of Contract.

B. Submittal shall include, but not be limited to the following:

1. equipment scheduled
2. balancing contractor
3. insulation
4. grilles, and diffusers
5. automatic temperature controls

6. certificates of guarantee
7. valves
8. plumbing fixtures, accessories, and specialties
9. any item for which more than one manufacturer is mentioned

C. Submit a minimum of five copies of data in binders and index in same order and name as they appear in Specification. - Optional: Provide electronic submittals. Electronic submittals shall be in .pdf format, and shall be compiled into a single file, with bookmarks for each piece of equipment.

1. State sizes, capacities, brand names, motor HP, electrical requirements, accessories, materials, gauges, dimensions, and other pertinent information.
2. List on catalog covers page numbers of submitted items.
3. Underline or highlight applicable data.

D. If material or equipment is not as specified or submittal is not complete, it will be rejected.

E. Catalog data or shop drawings for equipment which are noted as approved shall not supersede Contract Documents.

F. Review comments shall not relieve this Division from responsibility for deviations from Contract Documents unless attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.

G. Check work described by catalog data with Contract Documents for deviations and errors.

H. All items other than first named specified equipment shall show and state all exceptions and deviations taken and shall include design calculations and drawing layouts.

I. The Contractor shall review the submittals prior to submission to make sure that the submittals are complete in all details. No submittal will be reviewed which does not bear the contractor's notation that such checking has been made.

J. No partial submittals will be considered unless approved by the Engineer.

K. Manufacturers' names shall be mentioned as acceptable prior to bidding.

L. Contractor shall verify equipment dimensions to fit the spaces provided with sufficient clearance for servicing the equipment.

M. Contractor shall review equipment submittals for compliance with schedules, specifications, and drawing plans and details. Equipment submittal shall show the proper arrangements to suit installation and maintenance such as motor location, access doors, filter removal, piping connections, etc.

N. Equipment submittal sheets shall be clearly marked indicating equipment symbol and exact selection of proposed equipment. Submittals shall clearly indicate name of manufacturer of each item.

O. For unacceptable items, the right shall be reserved to require the first named specified items.

P. Where submittals are sent with any of the above listed information missing or are incomplete they will be returned to the contractor unchecked to be completed and resubmitted. No

additional time or money shall be allowed for failure to provide complete submittals on the first review.

Q. If an item requiring submittal review is ordered, purchased, shipped, or installed prior to the submittal review the item shall be removed from the job site and replaced with an approved item at contractors expense.

1.7 CLEANING & FINISHING:

A. Contractor shall, at all times, keep the premises free from waste material and rubbish. Upon completion of this Section of the work, Contractor shall remove all surplus materials and rubbish; clean all spots resulting from the mechanical work from hardware, floors, glass, walls, etc.; do all required patching up and repair all work of other trades damaged by Contractor under this Section of the work, and leave the premises in a clean orderly condition. Clean heating and cooling coils, internally and externally, and replace all air filters prior to final mechanical inspection. Remove rust, plaster, dirt, grease and oil before painting, insulating, or exposing to view the equipment, piping, ductwork, etc. in completed structure. Refinish any damaged surfaces and leave in proper working order at final completion.

1.8 EQUIPMENT SERVICING:

A. Prior to starting mechanical equipment, all motors, bearings and moving parts shall be properly oiled, greased and lubricated as required. Full and adequate maintenance service shall be given and upon completion all equipment shall be cleaned and checked and placed in perfect condition for the Owner.

B. Amount and type of lubricant shall be per manufacturer's specification.

1.9 SUPERVISION:

A. The Contractor shall supervise and direct the work with his best skill and attention. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor will be responsible to see that the finished work complies accurately with the Contract Documents.

1.10 SAFETY REGULATIONS:

A. Contractor shall provide equipment, supervision, construction, procedures, and everything necessary to assure safety of life or property.

B. Refer also to General Condition and Special Conditions for protection clauses.

1.11 LEAK DAMAGE:

A. Contractor shall be responsible for damages to the work of other Contractors or to the building, or to its contents, people, etc., caused by leaks in any of the equipment or piping installed by him through equipment or material failures, leaking joints or disconnected pipes, fittings, or by overflows and shall make at his own expense all repairs to fixtures, building interior, contents, paint, rugs, furniture, ceiling tile, and equipment so damaged.

1.12 TOOLS AND STORAGE OF EQUIPMENT:

A. The Contractor shall furnish all necessary tools, staging and whatever may be necessary for the installation of this work and shall at all times protect this work and others, and the materials to be used therein from damage by the weather, accident and other causes, and shall repair and make good any damage thus occurring.

1.13 WORKMANSHIP:

A. Workmanship shall be the best quality of its kind for respective industries, trades, crafts and practices and shall be acceptable in every respect to the Owner and Engineer. Nothing contained herein shall relieve the Contractor from performing good work, perfect in all details of construction.

1.14 PAINTING BY CONTRACTOR:

A. See section 09900 for painting requirements. See also section 15075 for color code requirements.

B. Painting shall be by persons experienced in painting.

C. All exposed, insulated, and bare piping, equipment, metal stands and supports shall be painted as follows:

1. The prime coat on equipment shall be factory applied. The finish coats shall be applied under Section 09900 of these specifications.
2. All equipment which is to be furnished in finished painted condition by Contractor shall be left without mark, scratch or impairment to finish upon completion and acceptance of job. Any necessary refinishing to match original shall be done by Contractor. Do not paint over name plates, serial numbers or other identifying marks.
3. All new piping shall be painted as required in Section 15075. Paint colors shall conform to color code requirements as specified in 15075 "Identification of Piping and Equipment".

1.15 ELECTRICAL WORK:

A. Power wiring to all electrically driven apparatus shall be done under the electrical contract. See Electrical Specifications.

B. Unless specifically noted otherwise on documents, Electrical Contractor shall furnish and install all magnetic starters including properly sized heaters, and disconnect switches as indicated on drawings or required by code.

C. The Contractor shall verify the proper operation of equipment furnished by him. Costs for repair, replacing, re-wiring and retesting shall be borne by the Contractor without additional costs to the Owner.

D. Motors shall be as specified.

1.16 INSPECTION NOTICE:

A. The following is a basic list of guideline items so that the Architect, district building inspector/Owner's representative can be at job site for these inspections as the building progresses. Mechanical Contractor shall inform these people one week in advance of test time.

1. Water tests on all sewer, waste, and rainwater piping prior to piping being concealed.
2. Pressure tests on all water service piping.
3. Pressure tests on hot, chilled, and condenser water supply and return piping.
4. All duct work prior to installation of finished ceilings, including ductwork pressure testing.
5. The initial start-up of mechanical equipment, etc.
6. Any changes or problems occurring at job site.
7. Inspect all vent flashings on roof prior to roofing.
8. Periodic inspection at their discretion will be made to insure compliance to Contract Documents and codes. Contractor shall provide ladders, access and other assistance as requested during inspections.
9. Control piping pressure tests.
10. Final inspection before giving approval for final payment.

1.17 EXCAVATION AND BACKFILLING:

A. Trench for the underground gas pipe line shall be excavated to the required depth. Rocks, trash, or other debris will not be allowed in trench or backfill and shall be removed before pipe is laid in place. After piping has been tested, inspected and approved, piping shall be backfilled. All landscaping, concrete, etc., damaged by this Contractor shall be replaced by him to the satisfaction of Owner's Representative.

1.18 WARRANTY GUARANTEE:

A. The Contractor shall warrant all materials and equipment to be of quality consistent with specifications as represented by manufacturer's published data.

B. The Contractor shall guarantee that the installation and operation of the equipment shall be free from defects for a period of one year beginning at date of substantial completion and acceptance. The Contractor shall replace or repair any part of the installation that is found to be defective or incomplete within the guarantee period.

C. The one year guarantee on equipment and systems shall commence when equipment has been demonstrated to work and has been accepted. (Example: If an equipment item fails to perform and it takes 9 months after substantial completion to correct, then the guarantee shall commence after the item has been demonstrated to perform and has been accepted.)

D. Substantial completion and acceptance in no way relieves the Contractor from providing the systems and equipment as specified.

1.19 COMPLETION SCHEDULE:

A. Start-up and verification of basic equipment items shall be done prior to the date of substantial completion with sufficient time to allow balancing and adjusting to be performed.

B. At the time of the final inspection a date shall be agreed upon for completion of any remaining items. At least double the estimated cost of the work will be withheld from the Contractor's payment.

1.20 CODE REQUIREMENTS, FEES, AND PERMITS

A. The work shall be installed in accordance with the following applicable codes, ordinances and standards unless otherwise specified. The codes and standards shall include but not be limited to and be of the latest and current editions.

1. American Boiler and Affiliated Industries (AB and AI)
2. American Gas Association (AGA)
3. Air Movement and Control Association (AMCA)
4. American National Standards Institute (ANSI)
5. Air Conditioning & Refrigeration Institute (ARI)
6. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) - ASHRAE 90.1-2010
7. American Society of Mechanical Engineers (ASME)
8. American Society of Testing Materials (ASTM)
9. American Standards Association (ASA)
10. American Water Works Association (AWWA)
11. American Welding Society (AWS)
12. Associated Air Balance Council (AABC)
13. Heat Exchange Institute (HEI)
14. Hydraulic Institute (HI)
15. BR
16. National Electrical Code (NEC)
17. National Fire Protection Association (NFPA)
18. Sheet Metal and Air Conditioning contractors National Association (SMACNA)
19. Underwriters Laboratories (UL)
20. International Building Code (IBC) 2012 Ed
21. International Mechanical Code (IMC) 2012 Ed
22. International Plumbing Code (IPC) with Utah Amendments 2012 Ed
23. International Energy Conservation Code (IECC) 2012 Ed
24. Utah State Safety Orders (OSHA/UOSH)
25. Utah Fire Rating Bureau
26. Utah Boiler and Pressure Vessel Law
27. Utah Air Conservation Regulations/Waste Disposal regulations.

28. ASHRAE Ventilation STD.62-2010

B. Should drawings conflict with any code, the code shall govern. If drawings and specifications establish a quality exceeding the code, the drawings and specifications shall govern. If conflicts do exist among the drawings, specifications and codes, the same shall be brought to the attention of the Engineer in writing prior to bidding, otherwise Contractor shall comply with applicable codes.

C. The latest edition of all codes shall be used.

D. Contractor shall give all notices, obtain all necessary permits, file necessary plans, prepare documents and obtain approvals, and pay all fees required for completion of the mechanical and plumbing work outlined in this Division of the specifications and shown on the Mechanical Drawings.

1.21 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS

A. Upon completion of work and before final payment, Contractor shall furnish and deliver to the Owner, through the Engineer, installation, operation and maintenance manuals with instructions for all new materials and equipment used in the building. The contractor shall provide three (3) hard copies of the manuals, and three (3) CD's with electronic copies of the manuals. Electronic information shall be .PDF format. The CD's shall include the same information as the hard copies, and shall be organized in the same manner with electronic bookmarks for each section. CD case and the CD itself shall be labeled the same as the hard copies of the manuals.

1.22 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Contractor shall instruct building maintenance personnel in the operation and maintenance of the installed mechanical systems utilizing the Operation and Maintenance Manual when so doing.

B. Minimum instruction periods shall be as follows -

1. Mechanical - Two hours.
2. Plumbing - Two hours.
3. Temperature Control - Two hours.

C. Instruction periods shall occur before final site observation when systems are properly working and before final payment is made.

D. None of these instructional periods shall overlap each other.

E. An additional four hours of instruction will be provided by each contractor, after 60 days of system operation by owner to insure proper system operation and answer questions.

1.23 RECORD DRAWINGS

A. Contractor shall keep an up-to-date set of mechanical and plumbing drawings in his custody showing all changes in red, clearly defined and neatly drafted by him. At the end of construction, he shall turn these drawings over to the Engineer. Record drawings must be completed and submitted prior to final site observation

.

PART 2 - PRODUCTS
(Not Used)

PART 3 - EXECUTION
(Not Used)

END OF SECTION 15010

SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

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. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Mechanical demolition.
7. Equipment installation requirements common to equipment sections.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Mechanical sleeve seals.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. 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.

B. All materials, piping, etc. shall be new, and domestically made of the best commercial quality obtainable, consistent with specified materials and for the purpose or function intended unless specifically approved in writing prior to bid.

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 mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 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.

2.2 JOINING MATERIALS

A. Refer to individual Division 15 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.

2.3 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.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel. 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.

2.5 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. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

E. PVC Pipe: ASTM D 1785, Schedule 40.

2.6 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, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

A. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Drawings do not show every offset, or bend that may be required. 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 where indicated on drawings and where penetrating will be visible to public.

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. 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:

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.

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.

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.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 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 Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 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.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 15050

SECTION 15074 - VIBRATION AND SEISMIC 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Freestanding and restrained spring isolators.
3. Seismic snubbers.
4. Restraining braces and cables.

1.3 SCOPE

A. Provide letter of design intent.

B. Provide full set of seismic submittals.

C. Provide final letter of compliance completion.

1.4 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.5 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: Per owner's design standards.
2. Building Classification Category: As defined in the IBC.
3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Site Class: As defined in the IBC.
2. Assigned Seismic Use Group or Building Category: As defined in the IBC.

    a. Component Importance Factor: 1.0.

1.6 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Letter of Design intent, stating company, design criteria, compliance with specifications and only exceptions that will apply. Letter shall be stamped and signed by a licensed and qualified professional engineer in this jurisdiction.

C. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to 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, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.

   a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 and 23 Sections for equipment mounted outdoors.

2. Riser Supports: 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. Vibration Isolation Base Details: 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. Seismic- and Wind-Restraint Details:

   a. Design Analysis: To support selection and arrangement of seismic and 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 spacing's. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 15 Sections for equipment mounted outdoors.
   d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction, showing

maximum ratings of restraint items and the basis for approval (tests or calculations).

D. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

E. Welding certificates.

F. Qualification Data: For professional engineer and testing agency.

G. Field quality-control test reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Upon project completion provide a final letter of acceptance for seismic restraints system and installation.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene or rubber.

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber

isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

B. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: -steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with

strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

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 seismic- and wind-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- 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 evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 15 Section "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Leave a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust air-spring leveling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 15074

SECTION 15075 - MECHANICAL IDENTIFICATION

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 mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment signs.
3. Access panel and door markers.
4. Pipe markers.
5. 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. Valve numbering scheme.

D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

a. Manufacturer, product name, model number, and serial number.
b. Capacity, operating and power characteristics, and essential data.
c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, 1/4” or larger with terms to match equipment identification.
3. Thickness: 1/8 inch, unless otherwise indicated.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

C. Access Panel and Door Markers: 1/16” thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8” center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, etc.
2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
4. Fans, blowers, primary balancing dampers, and mixing boxes.
5. Packaged HVAC central-station and zone-type units.

B. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.

1. Identify mechanical equipment with black equipment markers with white lettering.
2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
4. Include signs for the following general categories of equipment:

a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
b. Fuel-burning units, including boilers, furnaces, heaters, etc.
c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
e. Fans, blowers, primary balancing dampers, and mixing boxes.
f. Packaged HVAC central-station and zone-type units.
g. Tanks and pressure vessels.
h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

C. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

C. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.4 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.5 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 15075

SECTION 15080 - HVAC AND PLUMBING INSULATION

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. Insulation Materials:

   a. Mineral fiber.

2. Insulating cements.
3. Adhesives.
4. Lagging adhesives.
5. Factory-applied jackets.
6. Field-applied jackets.
7. Tapes.
8. Securements.
9. Corner angles.

B. Related Sections:

1. Division 15 Section "Metal Ducts" for duct liners.

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. Qualification Data: For qualified Installer.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

D. Field quality-control reports.

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.

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 15 Section "Hangers and Supports."

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 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. 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. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Duct insulation shall have a minimum R value = 5 for installation in an unconditioned space, and a minimum R value = 8 for installation outdoors. Provide a weather protective sheet metal jacket for outdoor installation.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

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.
f. Prior approved equal.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
2. Service Temperature Range: Minus 50 to plus 180 deg F.
3. Color: White.

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
7. Adhesion: 64 ounces force/inch in width.
8. Elongation: 500 percent.
9. Tensile Strength: 18 lbf/inch in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

2.8 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

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.

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, 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. For below ambient services, apply vapor-barrier mastic over staples.

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. 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 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.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 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.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. 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.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return, Air.
4. Indoor, exposed return, Air.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, concealed exhaust.
7. Indoor, exposed exhaust.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, low pressure, round rectangular, and flat-oval exhaust-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Rectangular, low pressure, supply-air duct insulation shall be lined per Section “Metal Ducts”.

D. Rectangular, return-air duct insulation shall be lined per Section “Metal Ducts”.

E. Exposed or medium pressure, round and flat-oval, supply-air, and return air duct insulation shall be a perforated linear. See Section “Metal Ducts”.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
4. Vertical roof drain piping.

C. Piping System insulation:

1. Hydronic Piping - Mineral Fiber, per chart.
2. Domestic Cold Water Piping -Mineral Fiber, ½”
3. Domestic Hot Water Piping -Mineral Fiber, per chart
4. Horizontal Roof Drain Piping - Mineral Fiber, 1/2”.
5. Refrigerant Piping - Flexible elastomeric, 1”.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Minimum Pipe Insulation Thickness from ANSI/ASHRAE/IESNA Standard 90.1-2010.

Fluid Operating Temperature Range and usage (F°)	Insulation Conductivity		Nominal Pipe or Tube Size (inches)				
	Conductivity Btu-in./(h-ft^2-F°)	Mean Rating Temp. F°	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
Heating Systems (Steam, Steam Condensate, and Hot Water)							
>350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.32	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.21-0.28	100	1.0	1.0	1.5	1.5	1.5
Cooling Systems (Chilled Water, Brine, and Refrigerant)							
40-60	0.21-0.27	75	0.5	0.5	1.0	1.0	1.0
<40	0.20-0.26	50	0.5	1.0	1.0	1.0	1.5

3.12 DUCT INSULATION SCHEDULE

A. Minimum Duct Insulation R-Value, Cooling and Heating Supply Ducts and Return Ducts ANSI/ASHRAE/IES Standard 90.1-2010.

Duct Location							
Climate Zone	Exterior	Ventilated Attic	Unvented Attic Above Insulated Ceiling	Unvented Attic with Roof Insulation	Unconditioned Space	Indirectly Conditioned Space	Buried
Heating- Only Ducts							
5	R-6	R-3.5	none	none	none	none	R-3.5
Cooling-Only Ducts							
5,6	R-3.5	R-1.9	R-3.5	R-1.9	R-1.9	none	none
Return Ducts							
1 to 8	R-3.5	R-3.5	R-3.5	none	none	none	none
Combine Heating and Cooling							

Supply Ducts							
5	R-6	R-6	R-6	R-1.9	R-3.5	none	R-3.5
Return Ducts							
1 to 8	R-3.5	R-3.5	R-3.5	none	none	none	none

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:

1. PVC: 20 mils thick.

3.14 OUTDOOR, FIELD APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Exterior piping, Exposed:

1. Aluminum jacket.

END OF SECTION 15080

SECTION 15140 - 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 1 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. Flexible connectors.
3. Escutcheons.
4. Sleeves and sleeve seals.
5. Wall penetration systems.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to 2012 IBC.

1.4 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Escutcheons.
5. Sleeves and sleeve seals.

B. Water Samples: Specified in "Cleaning" Article.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. 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.

2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.

C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.

D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.

E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.

G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.5 SLEEVES

A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

G. 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 setscrews.

2.6 SLEEVE SEALS

A. 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. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.7 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, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 2 Section "Earthwork" 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 ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.

E. 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 15 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 15 Section "Domestic Water Piping Specialties" for drain valves and strainers.

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

H. Install domestic water piping level without pitch and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install seismic restraints on piping. Comply with requirements in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. 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.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping adjacent to equipment and specialties to allow service and maintenance.

O. Install piping to permit valve servicing.

P. 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.

Q. Install piping free of sags and bends.

R. Install fittings for changes in direction and branch connections.

S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

T. Install thermostats in hot-water circulation piping. Comply with requirements in Division 15 Section "Domestic Water Pumps" for thermostats.

U. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 15 Section "Meters and Gages for Plumbing Piping" for thermometers.

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:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. 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."

F. 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.

G. 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 15 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 15 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 15 Section "Domestic Water Piping Specialties" for balancing valves.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 and Smaller: Fitting-type coupling.
2. NPS 2 and Larger: Sleeve-type coupling.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 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 15 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.

3.8 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, stamped steel with set screw or spring clips.
5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw or spring clips.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

C. Escutcheons for Existing Piping:

1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
2. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge and spring clips.
3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with exposed-rivet hinge and set screw or spring clips.
6. Bare Piping in Equipment Rooms: Split plate, stamped steel with set screw or spring clips.
7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.9 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.

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.

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 7 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 Insert type.
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 7 Section "Through-Penetration Firestop Systems" for firestop materials and installations.

3.10 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.

3.11 WALL PENETRATION SYSTEM INSTALLATION

A. Install wall penetration systems in new, exterior concrete walls.

B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.12 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 15 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.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed 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 100 psig, 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 and 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 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. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.

D. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B 88, Type L; grooved-joint copper-tube appurtenances; and grooved 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 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: Memory-stop 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.

END OF SECTION 15140

SECTION 15145 - 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 1 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. Temperature-actuated water mixing valves.
5. Strainers.
6. Hose bibbs.
7. Wall hydrants.
8. Drain valves.
9. Water hammer arresters.
10. Air vents.
11. Trap-seal primer valves.
12. Trap-seal primer systems.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties 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, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. 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. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Standard: ASSE 1011.
2. Body: Bronze, nonremovable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
4. Body: Bronze for NPS 2 and smaller; steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Accessories:

   a. Valves: Ball type with threaded ends on inlet and outlet ofNPS 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.

B. Hose-Connection Backflow Preventers:

1. Standard: ASSE 1052.
2. Operation: Up to 10-foot head of water back pressure.
3. Inlet Size: NPS 1/2 or NPS 3/4.
4. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
5. Capacity: At least 3-gpm flow.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 150 psig.
3. 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.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig (860 kPa).
3. Type: Exposed-mounting, thermostatically controlled water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Valve Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
8. Tempered-Water Setting: 110E F.
9. Tempered-Water Design Flow Rate: See drawings.
10. Pressure Drop at Design Flow Rate: See Drawings.
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. Standard: ASSE 1016, thermostatically controlled water tempering valve.
2. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
3. Body: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.
6. Finish: Rough or chrome-plated bronze.
7. Tempered-Water Setting: 110E F.
8. Tempered-Water Design Flow Rate: Coordinate with 15410.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Drain: Factory-installed, hose-end drain valve.

2.6 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.7 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig (860 kPa).
3. Operation: Loose key.
4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
5. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
6. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounting with cover.
8. Box and Cover Finish: Chrome plated.
9. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
10. Nozzle and Wall-Plate Finish: Polished nickel bronze.
11. Operating Keys(s): Two with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:

1. Standard: ASSE 1019, Type A or Type B.
2. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
3. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
4. Pressure Rating: 125 psig (860 kPa).
5. Operation: Loose key.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
8. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.8 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.9 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Metal bellows Copper tube with piston.
3. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.10 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.11 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig (860 kPa) minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
6. 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. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
2. Size: NPS 1-1/4 (DN 32) minimum.
3. Material: Chrome-plated, cast brass.

2.12 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Standard: ASSE 1044,
2. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
3. Cabinet: Recessed-mounting steel box with stainless-steel cover.
4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
5. Vacuum Breaker: ASSE 1001.
6. Number Outlets: See drawings.
7. Size Outlets: NPS 1/2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" 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 balancing valves in locations where they can easily be adjusted. Install on hot water recirculating lines where they connect to hot water lines.

E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve.

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

I. 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.

J. 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.

K. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 16 Section "Grounding and Bonding."

C. Connect wiring according to Division 16 Section "Conductors and Cables."

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. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Water pressure-reducing valves.
4. Calibrated balancing valves.
5. Primary, thermostatic, water mixing valves.
6. Supply-type, trap-seal primer valves.
7. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 15145

SECTION 15150 - 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 1 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.

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 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 Insert pressure.
2. Sanitary Sewer, Force-Main Piping: 100 psig.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

1.6 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 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent 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 or 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.

2. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 Section "Earthwork" 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 NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings and sovent stack fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

C. Aboveground, vent piping shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

D. Underground, soil, waste, and vent piping shall be any of the following:

1. Extra-Heavy class, cast-iron soil piping; gaskets; and gasketed calking materials; joints.

3.3 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 2 Section "Sanitary Sewerage."

B. Plastic piping is not allowed in ceiling return plenums. Where piping is exposed to ceiling plenums, cast iron shall only be allowed.

C. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

D. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

E. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

F. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

G. 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 15 Section "Basic Mechanical Materials and Methods."

H. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

I. 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.

J. 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.

K. 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.

L. 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.

M. 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. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

N. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

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.

3.5 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 15 Section "Mechanical Vibration Controls and Seismic Restraints."

B. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 15 Section "Hangers and Supports."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

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.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
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 required corrective action.

3.8 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.

END OF SECTION 15150

SECTION 15155 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Floor sinks.
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.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer, rated capacities, operating characteristics, and accessories for the following:

1. Cleanouts.
2. Floor drains.
3. Trench drains.
4. Air admittance valves.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

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 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 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
2. Size: Same as connected drainage piping
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
2. Size: Same as connected branch.
3. Type: Threaded, adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Threaded.
7. Closure: Cast-iron plug.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze or copper alloy.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
13. Standard: ASME A112.3.1.
14. Size: Same as connected branch.
15. Housing: Stainless steel.
16. Closure: Stainless steel with seal.
17. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.

2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, stainless-steel wall-installation frame and cover.

2.2 DRAINS

A. Drains:

B. Sanitary Floor Drain, BFD-320

1. Size: [3 inches] [4 inches] [Indicated on the Drawings].
2. Compliance:

   a. ASME A112.3.1.
   b. UPC

3. Drain Body:

   a. Material: Type 304, stainless steel.
   b. Outlet: Bottom outlet.

4. Grate:

   a. Material: Type 304, stainless steel.
   b. Diameter: 8”x 8” square grate.
   c. Thickness: 1/8”.

C. Sanitary Floor Drain, BFD-340

1. Size: [3 inches] [4 inches] [6 inches] [indicated on the drawings]
2. Compliance:

   a. ASME A112.3.1.
   b. UPC.

3. Drain Body:

   a. Material: Type 304, stainless steel.
   b. Outlet: Bottom outlet.

4. Grate:

   a. Material: Type 304, stainless steel.
   b. Diameter: 12” x 12” square grate.
   c. Thickness: 1/8”.

D. Waterline Shower Channel with Sheet Membrane Clamp:

1. Outlet size: [2 inches] [indicated on the drawings].
2. Compliance:

a. ASME A112.3.1.
b. UPC.

3. Drain Body:

a. Material: Type 304, stainless steel.
b. Outlet: Bottom outlet.
c. Seal: Dual O-ring seals.

4. Grate:

a. Material: Type 304, stainless steel.
b. Dimension: [3-1/4” x 26”] [3-1/4”x 30”] [3-1/4” x 36”] [3-1/4” x 42”] [3-1/4” x 48”] [3-1/4” x 60”] [3-1/4” x 72”] [indicated on the drawings}
c. Shape: Rectangular.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Standard: ASME A112.6.3.
2. Pattern: Floor drain.
3. Body Material: Gray iron.
4. Clamping Device: Required.
5. Outlet: Bottom.
6. Top or Strainer Material: Stainless steel.
7. Top Shape: Round.
8. Top Loading Classification: Medium Duty.
9. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
10. Trap Pattern: Deep-seal P-trap.
11. Trap Features: Trap-seal primer valve drain connection.

2.4 FLOOR SINK

A. 12x12x6 with square top, medium receptor cast iron body with flanged receptor, acid resistant coated interior, and acid resistant coated half grate. Aluminum sediment bucket and 3 inch caulked regular outlet connection and deep seal P-Traps.

2.5 TRENCH DRAINS

A. Trench Drains:

1. Standard: ASME A112.6.3 for trench drains.
2. Material: Ductile or gray iron.
3. Flange: Anchor.
4. Clamping Device: Required.
5. Outlet: As indicated on drawings.
6. Grate Material: Ductile iron.
7. Dimensions of Frame and Grate: As indicated on drawings.
8. Top Loading Classification: Medium Duty.

2.6 CHANNEL DRAINAGE SYSTEMS

A. Plastic Channel Drainage Systems:

1. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.

a. Channel Sections: Interlocking-joint, HDPE modular units, with end caps. Include flat, rounded, or inclined bottom, with level invert and with outlets in number, sizes, and locations indicated.

1) Dimensions: 4 inches wide. Include number of units required to form total lengths indicated.

b. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.

1) Material: Gray iron.

c. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.

d. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.7 AIR-ADMITTANCE VALVES

A. Wall Box:

1. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
2. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.8 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-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.

2.9 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
2. Size: Same as connected soil, waste, or vent stack.
3. 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.

4. 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.
5. Special Coating: Corrosion resistant on interior of fittings.

2.10 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

D. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.11 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.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. 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.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. 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.

F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

G. 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.

H. Install air-admittance-valve wall boxes recessed in wall where indicated on drawings.

I. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

J. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

K. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

L. Install deep-seal traps on all floor drains.

M. 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.

N. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

O. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

P. Install vent caps on each vent pipe passing through roof.

Q. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

R. 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 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

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 7 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.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

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.

END OF SECTION 15155

SECTION 15195 - FACILITY NATURAL-GAS PIPING

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. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.

B. Welding certificates.

C. Field quality-control reports.

D. Operation and Maintenance Data: For pressure regulators to include in operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. 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.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Owner's written permission.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. 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.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Body: Bronze, complying with ASTM B 584.
2. Ball: Chrome-plated brass.
3. Stem: Bronze; blowout proof.
4. Seats: Reinforced TFE; blowout proof.
5. Packing: Separate packnut with adjustable-stem packing threaded ends.
6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. CWP Rating: 600 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25.

1. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
2. Maximum Operating Pressure: 5 psig.
3. Cast-aluminum body with nickel-plated chrome steel internal parts.
4. Nitrile-rubber valve washer.
5. Sight windows for visual indication of valve position.
6. Threaded end connections complying with ASME B1.20.1.
7. Wall mounting bracket with bubble level indicator.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.

2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Pressure Regulators: Comply with ANSI Z21.80.

1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: [100 psig] <Insert pressure>.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Install fittings for changes in direction and branch connections.

E. 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.

F. 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.

G. 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.

H. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 15 Section "Meters and Gages."

3.4 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install escutcheons at penetrations of interior walls, ceilings, and floors.

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    d. Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    e. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated or rough-brass finish.

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 7 Section "Through-Penetration Firestop Systems."

M. Verify final equipment locations for roughing-in.

N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

R. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

    a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:

   a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
   b. Do not install natural-gas piping in solid walls or partitions.

S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

T. Connect branch piping from top or side of horizontal piping.

U. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

V. Do not use natural-gas piping as grounding electrode.

W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 15 Section "Meters and Gages."

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.6 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.
   3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
   4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
   5. 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.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.7 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Division 15 Section "Hangers and Supports."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.8 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

A. Comply with requirements in Division 15 Section "Mechanical Identification" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 PAINTING

A. Comply with requirements in Division 9 painting Sections for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (flat).
d. Color: By owner.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

a. Prime Coat: Quick-drying alkyd metal primer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex (semigloss).
d. Color: By owner.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

3.13 INDOOR PIPING SCHEDULE

A. Aboveground, branch piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping 2” and larger shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:

1. One-piece, bronze ball valve with bronze trim.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, lubricated plug valve.

END OF SECTION 15195

SECTION 15410 - PLUMBING FIXTURES

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 conventional plumbing fixtures and related components:

1. Lavatories.
2. Lavatory Faucets.
3. Water closets.
4. Toilet seats.
5. Flushometers - Water Closets.
6. Urinals.
7. Flushometers - Urinals.
8. Fixture supports.
9. Protective shielding guards.
10. Commercial sinks.
11. Sink Faucets.
12. Service sinks.

B. Related Sections include the following:

1. Division 15 Section "Plumbing 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. Operation and Maintenance Data: For plumbing fixtures to include in operation, and maintenance manuals.

C. 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"; 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. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
4. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
5. Vitreous-China Fixtures: ASME A112.19.2M.
6. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
7. Water-Closet, Flushometer Tank Trim: ASSE 1037.

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 miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Manual-Operation Flushometers: ASSE 1037.
4. Plastic Tubular Fittings: ASTM F 409.
5. Brass Waste Fittings: ASME A112.18.2.
6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Flexible Water Connectors: ASME A112.18.6.
3. Floor Drains: ASME A112.6.3.
4. Grab Bars: ASTM F 446.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Hot-Water Dispensers: ASSE 1023 and UL 499.
7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.
9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools 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: One year from date of Substantial Completion.

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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 2 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.

PART 2 - PRODUCTS

2.1 LAVATORIES

A. Lavatories:
1. Manufacturers: Kohler, Crane, American Standard, and Eljer.
2. Description: Accessible, wall-mounting, vitreous-china fixture.

a. Type: With back.
b. Size: 20 by 18 inches rectangular.
c. Faucet Hole Punching: Three holes, 4-inch centers.
d. Color: White.
e. Supplies: NPS 3/8 chrome-plated copper with stops.
f. Drain: Grid with offset waste.

1) Location: Near back of bowl.

B. Lavatories, Counter Mounted:
1. Manufacturers: Kohler, Crane, American Standard, and Eljer.

2. Description: Accessible Counter-mounting, vitreous-china fixture.

a. Type: Self-rimming.
b. Oval Lavatory Size: 20 by 17 inches.
c. Faucet Hole Punching: Three holes, 4-inch centers.
d. Color: White.
e. Supplies: NPS 3/8 chrome-plated copper with stops.
f. Drain: Grid with offset waste.

1) Location: Near back of bowl.

C. Mixing valve:

1. Valve shall be thermostatic and pressure mixing valve with maximum 5 degree approach temperature.

2.2 LAVATORY FAUCETS

A. Lavatory Faucets:
   1. Manufacturers: Delany, Zurn, Symmons, Chicago Faucet, Kohler, and Just

   2. Description: Sensor. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

      a. Body Material: Commercial, solid brass.
      b. Finish: Polished chrome plate.
      c. Maximum Flow Rate: 2.2 gpm.
      d. Centers: 4 inches.
      e. Mounting: Deck, concealed.
      f. Spout: Rigid type.
      g. Spout Outlet: Aerator.
      h. Drain: Grid.
      i. Tempering Device: Thermostatic.

2.3 WATER CLOSETS

A. Water Closets, Wall Mounted Flush Valve:
   1. Manufacturers: Kohler, Eljer, Crane, Toto and American Standard.
   2. Description Accessible, Where indicated on drawings, wall Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
      a. Style: Flushometer valve.

         1) Bowl Type: Elongated with siphon-jet design.
         2) Design Consumption: 1.6 gal./flush.
         3) Color: White.

      b. Flushometer.

B. Water Closets, Floor mounted-flushvalve:
   1. Manufacturers: Kohler, Eljer, Crane, Toto and American Standard.

   2. Description: Accessible where indicated on drawings, Floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.

         1) Bowl Type: Elongated Round front with siphon-jet design. Include bolt caps matching fixture.
         2) Height: Accessible where indicated on drawings.
         3) Design Consumption: 1.6 gal./flush.
         4) Color: White.

2.4 TOILET SEATS

A. Toilet Seats:

   1. Description: Toilet seat for water-closet-type fixture.

      a. Material: Molded, heavy duty, solid, anti-microbial plastic, with fire retardant.
      b. Configuration: Open front without cover.
      c. Hinge Type: Stainless Steel, self-sustaining.

d. Class: Standard commercial.
e. Color: White.

2.5 FLUSHOMETERS-WATER CLOSETS

A. Flushometers, Water Closets:
1. Manufacturers: Delany, Zurn, Sloan

2. Description: Flushometer for water closet fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Diaphragm operation.
b. Style: Exposed.
c. Inlet Size: NPS 1”.
d. Trip Mechanism: Battery-operated sensor actuator.
e. Consumption: 1.6 gal./flush.

2.6 URINALS

A. Urinals:
1. Manufacturers: Kohler, Eljer, Crane, Toto and American Standard.

2. Description: Accessible, where indicated on drawings, Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.

a. Type: Blowout with extended shields.
b. Strainer or Trapway: Open trapway with integral trap.
c. Design Consumption: 1 gal./flush.
d. Color: White.
e. Supply Spud Size: NPS 3/4.
f. Outlet Size: NPS 1-1/2.

2.7 FLUSHOMETERS-URINALS

A. Flushometers, Urinals:
1. Manufacturers: Delany, Zurn, Sloan

2. Description: Flushometer for urinal-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Diaphragm operation.
b. Style: Exposed.
c. Inlet Size: NPS 3/4.
d. Trip Mechanism: Battery-operated sensor actuator.
e. Consumption: 1.0 gal./flush.

2.8 FIXTURE SUPPORTS

A. Water-Closet Supports:

1. Description: Combination carrier designed for accessible or standard mounting height as required of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

B. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

C. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Sink Supports:

1. Description: Type II, sink carrier with hanger plate, bearing studs, and tie rod for sink-type fixture. Include steel uprights with feet.

2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Piping Enclosures:

1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.10 COMMERCIAL SINKS

A. Commercial Sinks, Single Compartment Break Room Sink:
1. Manufacturers: Kohler, Eljer, Elkay, Just, and American Standard.
2. Description: One-compartment, counter-mounting, stainless-steel commercial sink with backsplash.

a. Overall Dimensions: See drawings.
b. Metal Thickness: 18 Gauge.
c. Compartment:

1) Drain: NPS 1-1/2 tailpiece with stopper.

a) Location: Centered in compartment.

B. Commercial Sinks, Two Compartment:
1. Manufacturers: Kohler, Eljer, Elkay, Just, and American Standard.

2. Description: Two-compartment, freestanding, stainless-steel commercial sink with backsplash.

   a. Overall Dimensions: See drawings.
   b. Metal Thickness: 18 Gauge.
   c. Compartment:

      1) Dimensions: See drawings.
      2) Drain: NPS 1-1/2 tailpiece with stopper.

         a) Location: Centered in compartment.

2.11 SINK FAUCETS

A. Sink Faucets:
   1. Manufacturers: Delany, Zurn, Symmons, Chicago Faucet, Kohler, and Just

   2. Description: Kitchen faucet without spray. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

      a. Body Material: Commercial, solid brass.
      b. Finish: Polished chrome plate.
      c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
      d. Mixing Valve: Single control.
      e. Mounting: Deck.
      f. Handle(s): Lever.
      g. Spout Type: Swing, solid brass.
      h. Spout Outlet: Aerator.

         Drain: basket strainer

2.12 SERVICE SINKS

A. Service Sinks:

   1. Description: Floor-mounting, enameled, cast-iron fixture with front apron, raised back, and coated, wire rim guard.

      a. Size: 28 by 28 inches.
      b. Color: White.
      c. Faucet: Sink American Standard 8344.111 with threaded spout and48 inch hose and damp or equal by

         1) Eljer.
         2) Kohler.
         3) Speakman.

      d. Drain: Grid with NPS 2 outlet.

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 15 Section "Valves."

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 traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

T. 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.

U. 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 15 Section "Basic Mechanical Materials and Methods."

V. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 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 16 Section "Grounding and Bonding."

D. Connect wiring according to Division 16 Section "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

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust all fixtures. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. 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.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 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.

END OF SECTION 15410

SECTION 15412 - EMERGENCY PLUMBING FIXTURES

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 emergency plumbing fixtures:

1. Combination units.
2. Water-tempering equipment.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Cooled Water: Cooled potable water produced by water cooler.

C. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

D. PVC: Polyvinyl chloride plastic.

E. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

F. Tepid: Approximately 85 deg F (29 deg C) temperature.

1. Allowable Variation: Plus or minus 5 deg F (3 deg C).

1.4 SUBMITTALS

A. Product Data: Include flow rates and capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

E. Maintenance Data: For emergency plumbing fixtures to include in maintenance manuals specified in Division 1.

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. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

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";] about plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.

E. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

1.6 COORDINATION

A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

A. Combination Units: Owner provided and installed by Contractor, plumbed, accessible, freestanding type with emergency shower and eye/face wash equipment.

2.2 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water-Tempering Equipment, Factory-fabricated equipment including water thermostatic mixing valve designed to provide 85 deg F (29 deg C) potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F (3 deg C) throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, corrosion-resistant metal piping, and enclosure.

1. Manufacturers:

a. Bradley Corporation.
b. Encon Safety Product
c. Haws Corporation
d. Lawler Manufacturing Co., Inc.
e. Leonard Valve Co..
f. Western Emergency Equipment.

2.3 SOURCE QUALITY CONTROL

A. Certify performance of plumbed emergency plumbing fixtures by independent testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components according to manufacturer's written instructions.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball valve. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Refer to Division 15 Section "Valves" for general-duty shutoff valves.

1. Exception: Omit shutoff valves on valved supplies to group of plumbing fixtures that includes emergency plumbing fixture.
2. Exception: Omit shutoff valves on supplies to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for dielectric fittings.

F. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.

3.4 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.

3.5 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 15412

SECTION 15452 - DRINKING WATER COOLING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To

1. Furnish and install drinking water cooling system as described in Contract Documents.

B. Related Sections

1. General Conditions, Division 01, and Sections 15055 and 15060 apply to This Section.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Double Level Handicapped Fountain

1. Vandal proof operating bar on front and both sides. 7-1/2 GPH of 50 deg F water with 90 deg F room temperature, 1/5 horsepower compressor motor, 120 V, 60 Hz, single phase. One piece stainless steel back splash and basin. Flexi-guard or chrome plated brass bubbler. ADA accessible
2. Approved Manufacturers & Models -
   a. Elkay, Acorn Aqua, Halsey-Taylor, Haws, Oasis, and Sunroc

PART 3 - EXECUTION

3.1 INSTALLATION

A. ADA Fountain
1. Anchor bottom of fountain to wall.
2. Top surface to be 32 inches above floor unless required otherwise by local code.
3. Install 3/8 inch IPS union connection and Chicago No. 376 stop to building supply line.
4. Install 1-1/4 inch IPS slip cast brass "P" trap. Install trap so it is concealed.

END OF SECTION 15452

SECTION 15460 – NATURAL GAS-FIRED STORAGE TYPE WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To

1. Furnish and install water heater as described in Contract Documents.

B. Related Sections

1. General Conditions, Division 01, and Section 15050 and 15060 apply to this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Water Heaters

1. Glass lined storage tank, pressure tested and rated for 150 psig complete with thermostat, high limit control, gas valve, gas pressure regulator, 100% safety shut-off, and draft diverter. AGA approved for use with gas system.
2. Water Heater to meet National Appliance Energy Conversation Act (NAECA) and ASHREA 90 standard. Minimum efficiency of 80%.
3. Water heaters shall each have temperature-pressure relief valve sized to match heat input and set to relieve at 120 PSI.
4. 50 Gallon - (Standard Type)
   a. With five year tank warranty.
   b. Approved Manufacturers -
      1) Bradford-White
      2) AO Smith
      3) Lochinvar

2.2 ACCESSORIES

A. Anchoring Components

1. 1" x 18 ga galvanized steel straps
2. #10 x 2 1/2" screws

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install temperature-pressure relief valve on hot water heater and pipe discharge to floor drain/sink.

B. Anchor water heaters to wall using two anchoring straps and specified screws.

C. Install water heater on a 4” high concrete house-keeping pad. Pad to be 4” larger than the base of the water heater in all directions.

END OF SECTION 15460

SECTION 15530 - FURNACES

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. Gas-fired, condensing furnaces and accessories complete with controls.
2. Air filters.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each of the following:

1. Furnace.
2. Air filter.
3. Refrigeration components.

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.

C. Operation and Maintenance Data: For each furnace to include in operation, and maintenance manuals for each of the following:

1. Furnace and accessories complete with controls.
2. Refrigeration components.

D. Warranty: Special warranty specified in this Section.

1.4 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.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of furnaces that fail in materials or workmanship within specified warranty period:

1. Warranty Period, Commencing on Date of Substantial Completion:

a. Furnace Heat Exchanger: 10 years.
b. Integrated Ignition and Blower Control Circuit Board: Five years.
c. Draft-Inducer Motor: Five years.
d. Refrigeration Compressors: 10 years.
e. Evaporator and Condenser Coils: Five years.

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. Disposable Air Filters: Furnish two complete sets.

PART 2 - PRODUCTS

2.1 GAS-FIRED FURNACES, CONDENSING

A. General Requirements for Gas-Fired, Condensing Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21.47/CSA 2.3, "Gas-Fired Central Furnaces," and with NFPA 54.

B. Manufacturers:
1. Trane
2. Carrier
3. Bryant
4. Lennox
5. York

C. Cabinet: Steel.

1. Cabinet interior around heat exchanger shall be factory-installed insulation.
2. Lift-out panels shall expose burners and all other items requiring access for maintenance.
3. Factory paint external cabinets in manufacturer's standard color.

D. Fan: Centrifugal, factory balanced, resilient mounted, direct drive, variable speed.

1. Special Motor Features: Variable speed, premium efficiency, as defined in Division 15 Section "Motors," and with internal thermal protection and permanent lubrication.
2. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
3. Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.

E. Type of Gas: Natural.

F. AFUE: 90 percent.

G. Heat Exchanger:

1. Primary: Aluminized steel.

H. Burner:

1. Gas Valve: 100 percent safety two-stage main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
2. Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.

I. Gas-Burner Safety Controls:

1. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven; stops gas flow on ignition failure.
2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.

J. Combustion-Air Inducer: Centrifugal fan with thermally protected motor and sleeve bearings prepurges heat exchanger and vents combustion products; pressure switch prevents furnace operation if combustion-air inlet or flue outlet is blocked.

K. Furnace Controls: Solid-state board integrates ignition, heat, cooling, and fan speeds; adjustable fan-on and fan-off timing; terminals for connection to accessories.

L. Accessories:

1. Combination Combustion-Air Intake and Vent: PVC plastic fitting to combine combustion-air inlet and vent through outside wall or roof.
2. Plastic Vent Materials.

a. CPVC Plastic, Schedule 40 Pipe: ASTM F 441/F 441M.

1) CPVC Plastic, Schedule 40 Fittings: ASTM F 438, socket type.
2) CPVC Solvent Cement: ASTM F 493.

b. PVC Plastic, Schedule 40 Pipe: ASTM D 1785.

1) PVC Plastic, Schedule 40 Fittings: ASTM D 2466, socket type.
2) PVC Solvent Cement: ASTM D 2564.

M. Capacities and Characteristics: See drawings.

2.2 AIR FILTERS

A. Disposable Filters: 1-inch- thick, disposable, fiberglass type in sheet metal frame.

2.3 REFRIGERATION COMPONENTS

A. Refrigerant Coil: Copper tubes mechanically expanded into aluminum fins. Comply with ARI 210/240, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment." Match size with furnace. Include condensate drain pan with accessible drain outlet.

1. Refrigerant Coil Enclosure: Steel, matching furnace and evaporator coil, with access panel and flanges for integral mounting at or on furnace cabinet and galvanized sheet metal drain pan coated with black asphaltic base paint.

B. Refrigerant Piping: Comply with requirements in Division 15 Section "Refrigerant Piping."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine factory-installed insulation before furnace installation. Reject units that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install gas-fired furnaces and associated fuel and vent features and systems according to NFPA 54.

B. Suspended Units: Suspend from structure using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.

1. Install seismic restraints to limit movement of furnace by resisting code-required seismic acceleration.

C. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.

1. Anchor furnace to substrate to resist code-required seismic acceleration.

D. Controls: Install thermostats and humidistats at mounting height of 60 inches above floor.

E. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.

3.3 CONNECTIONS

A. Gas piping installation requirements are specified in Division 15 Section "Fuel Gas Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Vent Connection, Noncondensing, Gas-Fired Furnaces: Connect Type B vents to furnace vent connection and extend outdoors. Type B vents and their installation requirements are specified in Division 15 Section "Breechings, Chimneys, and Stacks."

D. Vent and Outside-Air Connection, Condensing, Gas-Fired Furnaces: Connect plastic piping vent material to furnace connections and extend outdoors. Terminate vent outdoors with a cap and in an arrangement that will protect against entry of birds, insects, and dirt.

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

   a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   b. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   c. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

4. Slope pipe vent back to furnace or to outside terminal.

E. Connect ducts to furnace with flexible connector. Comply with requirements in Division 15 Section "Duct Accessories."

F. Connect refrigerant piping to refrigerant coil in furnace and to air-cooled, compressor-condenser unit.

1. Flared Joints: Use ASME B16.26 fitting and flared ends, following procedures in CDA's "Copper Tube Handbook."
2. 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.
3. 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.

G. Comply with requirements in Division 15 Section "Refrigerant Piping" for installation and joint construction of refrigerant piping.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical test and visual and mechanical inspection.
2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
4. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

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 casings.
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. Adjust fan belts to proper alignment and tension.

C. Start unit according to manufacturer's written instructions and complete manufacturer's operational checklist.

D. Measure and record airflows.

E. Verify proper operation of capacity control device.

F. After startup and performance test, lubricate bearings.

3.6 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set controls, burner, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

3.7 CLEANING

A. After completing installation, clean furnaces internally according to manufacturer's written instructions.

B. Install new filters in each furnace within 14 days after Substantial Completion.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain condensing units. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 15530

SECTION 15542 - GAS-FIRED RADIANT HEATERS

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 gas-fired, tubular infrared radiant heaters.

1.3 SUBMITTALS

A. Product Data: For each type of gas-fired radiant heater indicated. Include rated capacities, operating characteristics, and accessories.

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."

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.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For gas-fired radiant heaters to include in operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.4 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.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gas-fired radiant heater that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

1.6 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. Burner Igniters: One hot-surface burner igniter(s) for each style of gas-fired radiant heater furnished.

PART 2 - PRODUCTS

2.1 TUBULAR INFRARED HEATERS

A. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.20/CSA 2.34.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Reznor/Thomas & Betts Corporation.
2. Roberts-Gordon, Inc.
3. Schwank Inc.
4. Solaronics, Inc.
5. Sterling HVAC Products; Div. of Mestek Technology Inc.
6. Reverber Ray
7. Prior approved equal.

C.

D. Fuel Type: Design burner for natural gas having characteristics same as those of gas available at Project site.

E. Combustion Tubing: 4-inch- diameter aluminized steel with high-emissivity, high-temperature, corrosion-resistant external finish.

F. Tubing Connections: Stainless-steel couplings or flared joints with stainless-steel draw bolts.

G. Reflector: Polished aluminum, 97 percent minimum reflectivity, with end caps. Shape to control radiation from tubing for uniform intensity at floor level with 100 percent cutoff above centerline of tubing. Provide for rotating reflector or heater around a horizontal axis for minimum 30-degree tilt from vertical.

1. Reflector Extension Shields: Same material as reflectors, arranged for fixed connection to lower reflector lip and rigid support to provide 100 percent cutoff of direct radiation from tubing at angles greater than 30 degrees from vertical.
2. Include hanger kit.

H. Burner Safety Controls:

1. Gas Control Valve: Single-stage, regulated redundant 24-V ac gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
2. Blocked Vent Safety: Differential pressure switch in burner safety circuit to stop burner operation with high discharge or suction pressure.
3. Control Panel Interlock: Stops burner if panel is open.
4. Indicator Lights: Burner-on indicator light.

I. Burner and Emitter Type: Gravity-vented power burner, with the following features:

1. Emitter Tube: 4-inch- diameter, hot-rolled-steel tubing with sight glass for burner and pilot flame observation.
2. Venting: Connector at exit end of emitter tubing for vent-pipe connection.

3. Burner/Ignition: Power gas burner with electronic spark and electronic flame safety.
4. Combustion-Air Connection: Duct connection for combustion air to be drawn directly from outdoors by burner fan.

2.2 CONTROLS

A. Thermostat: 2-stage, wall-mounting type with 50 to 90 deg F operating range and fan on switch.

1. Control Transformer: Integrally mounted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and connect gas-fired radiant heaters and associated fuel and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written installation instructions.

B. Suspended Units: Suspend from substrate using chain hanger kits and building attachments.

1. Spring hangers and seismic restraints are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."
2. Restrain the unit to resist code-required horizontal acceleration. Seismic restraints are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

C. Maintain manufacturers' recommended clearances to combustibles.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to gas-fired radiant heaters to allow service and maintenance.

C. Gas Piping: Comply with Division 15 Section "Fuel Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.

D. Vent Connections: Comply with Division 15 Section "Breechings, Chimneys, and Stacks."

E. Electrical Connections: Comply with applicable requirements in Division 16 Sections.

1. Install electrical devices furnished with heaters but not specified to be factory mounted.

3.3 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.

B. 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 installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Verify bearing lubrication.
3. Verify proper motor rotation.
4. Test Reports: Prepare a written report to record the following:

a. Test procedures used.
b. Test results that comply with requirements.
c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

3.4 ADJUSTING

A. Adjust initial temperature set points.

B. Adjust burner and other unit components for optimum heating performance and efficiency.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gas-fired radiant heaters. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 15542

SECTION 15576 - FLUES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To

1. Furnish and install flues as described in Contract Documents.

B. Related Sections

1. Division 09 - Painting
2. Section 15000 - General Mechanical Requirements

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Flues Type B

1. Double wall, prefabricated sectional type 'B', of aluminum construction designed to handle combustion products of fuel being used. Provide with inspection cap as required by local code, roof flashing, and clean-out.
2. Size flues according to local codes except -
   a. No vertical flue shall have an area of less than 12-1/2 sq inches (4 inches in diameter).
   b. In no case shall vent connector be smaller than outlet collar provided by Manufacturer.
3. Horizontal flue connectors shall be double wall.
4. Fittings shall be pre-fabricated double wall.
5. Vent Caps

   1. Non-backdraft type for installation on top of flue, aluminum construction.

B. STEEL, DOUBLE-WALL VENTS – TYPE L

1. Description: Double-wall metal stacks complying with NFPA 211, suitable for use with building heating equipment burning gas, solid, or liquid fuels.
2. Construction: Inner and outer metal shells separated by at least 1-inch airspace, with positive sealing joints.
3. Inner Shell: ASTM A 666, Type 304 stainless steel of the following thickness' 6- to 36-Inch. Size: 0.035 inch thick
4. Outer Jacket: Aluminum-coated steel of the following thickness: : 6- to 24-Inch Size: 0.025 inch thick.
5. Accessories: Tees, elbows, increasers, draft hood connectors, termination,

adjustable roof flashing, storm collar, support assembly, thimbles, firestop spacers, and fasteners; fabricated of similar materials and designs as vent-pipe straight sections.

a. Termination: Round chimney top designed to exclude 98 percent of rainfall

PART 3 EXECUTION

3.1 INSTALLATION

A. Height of flue above roof shall be as shown on Drawings unless local code requires it be higher.

B. Every portion of flue connector shall have rise of one inch per ft minimum from appliance to vertical flue.

C. Length of horizontal flues or flue connectors shall not be longer than 75% of height of vertical flue between points at which horizontal flue enters vertical flue to top of vertical flue. In no case shall horizontal run exceed 15 feet.

D. When two or more flue connections enter common vertical flue, smaller flue connector shall enter at higher level. Do not enter flue connectors in same horizontal plane.

E. Every gas appliance flue shall have a "backdraft preventer" installed at top of flue.

END OF SECTION 15576

SECTION 15671 - CONDENSING UNITS

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 air-cooled condensing units.

1.3 SUBMITTALS

A. Product Data: For each condensing unit, include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that condensing units, accessories, and components will withstand seismic forces defined in Division 15 Section "Mechanical Vibration and Seismic Controls." 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.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For condensing units to include in 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 condensing units and are based on the specific system indicated. Refer to Division 1 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."

1. Units shall be designed to operate with HCFC-free refrigerants.

D. ASME Compliance: Fabricate and label water-cooled condensing units to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

C. Coordinate location of piping and electrical rough-ins.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Compressor failure.
b. Condenser coil leak.

2. Warranty Period: Four years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONDENSING UNITS, AIR COOLED, 1 TO 5 TONS

A. Description: Factory assembled and tested, consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.

B. Manufacturers:
   1. Trane
   2. Carrier
   3. Bryant
   4. Lennox
   5. York

C. Compressor: Scroll, hermetically sealed, with rubber vibration isolators.

   1. Motor: Includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
   2. Two-Speed Compressor: Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
   3. Accumulator: Suction tube.
   4. Refrigerant Charge: [R-22] [R-407C] [R-410A] <Insert type>.

D. Condenser Coil: Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, with removable drain pan and brass service valves with service ports.

E. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection[and ball bearings].

F. Accessories:

   1. Crankcase heater.
   2. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.
   3. [Electronic programmable thermostat] [Low-voltage thermostat and subbase] to control condensing unit and evaporator fan.
   4. Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.
   5. Filter-dryer.
   6. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.
   7. Liquid-line solenoid.
   8. Low Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F [with time-delay relay to bypass low-pressure switch].
   9. Low Ambient Controller: Controls condenser fan speed to permit operation down to minus 20 deg F [with time-delay relay to bypass low-pressure switch].
   10. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.
   11. PE mounting base to provide a permanent foundation.
   12. Precharged and insulated suction and liquid tubing.
   13. Sound Hood: Wraps around sound attenuation cover for compressor.
   14. Thermostatic expansion valve.
   15. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.
   16. <Insert accessories.>

G. Unit Casing: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

2.2 CONDENSING UNITS, AIR COOLED, 6 TO 120 TONS

A. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.

B. Compressor: Hermetic or semihermetic compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.

1. Capacity Control: [Cylinder unloading] [Hot-gas bypass].
2. Refrigerant Charge: [R-22] [R-407C] [R-410A] [HFC-134a] <Insert type>.

C. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.

D. Condenser Fans: Propeller-type vertical discharge; either directly or belt driven. Include the following:

1. Permanently lubricated ball-bearing motors.
2. Separate motor for each fan.
3. Dynamically and statically balanced fan assemblies.

E. Operating and safety controls include the following:

1. Manual-reset, high-pressure cutout switches.
2. Automatic-reset, low-pressure cutout switches.
3. Low oil pressure cutout switch.
4. Compressor-winding thermostat cutout switch.
5. Three-leg, compressor-overload protection.
6. Control transformer.
7. Magnetic contactors for compressor and condenser fan motors.
8. Timer to prevent excessive compressor cycling.

F. Accessories:

1. [Electronic programmable thermostat] [Low-voltage thermostat and subbase] to control condensing unit and evaporator fan.
2. Low Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F [with time-delay relay to bypass low-pressure switch].
3. Low Ambient Controller: Controls condenser fan speed to permit operation down to minus 20 deg F [with time-delay relay to bypass low-pressure switch].
4. Gage Panel: Package with refrigerant circuit suction and discharge gages.
5. Hot-gas bypass kit.
6. Part-winding-start timing relay, circuit breakers, and contactors.
7. <Insert accessories.>

G. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:

1. Steel, galvanized or zinc coated, for exposed casing surfaces; treated and finished with manufacturer's standard paint coating.
2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
3. Gasketed control panel door.

4. Nonfused disconnect switch, factory mounted and wired, for single external electrical power connection.
5. Condenser coil [hail guard] [grille] to protect coil from physical damage.

2.3 MOTORS

A. General requirements for motors are specified in Division 15 Section "Motors."

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 16 Sections.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate condensing units according to ARI.

1. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
2. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

B. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. 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 condensing units.

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 condensing units 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 condensing units on concrete base. Concrete base is specified in Division 15 Section "Basic Mechanical Materials and Methods," and concrete materials and installation requirements are specified in Division 3.

C. Concrete Bases:

1. Install dowel rods to connect concrete base to concrete slab. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of the base.
2. For equipment supported on structural slab, 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.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

D. Install roof-mounting units on equipment supports specified in Division 7.

E. Vibration Isolation: Mount condensing units on rubber pads with a minimum deflection of 1/4 inch. Vibration isolation devices and installation requirements are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

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 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.

D. Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Division 15 Section "Refrigerant Piping."

E. Connect refrigerant and condenser-water piping to water-cooled condensing units. Maintain clear tube removal space. Refrigerant piping and specialties are specified in Division 15 Section "Refrigerant Piping" and condenser-water piping and specialties are specified in Division 15 Section "[Domestic Water Piping] [Hydronic Piping]."

F. Ground equipment according to Division 16 Section "Grounding and Bonding."

G. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical test and visual and mechanical inspection.
2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.

B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

C. Remove and replace malfunctioning condensing units 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. Adjust fan belts to proper alignment and tension.

E. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

F. Measure and record airflow over coils.

G. Verify proper operation of condenser capacity control device.

H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

I. After startup and performance test, lubricate bearings and adjust belt tension.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain condensing units. Refer to Division 1 Section "Closeout Procedures Demonstration and Training."

END OF SECTION 15671

SECTION 15815 - METAL DUCTS

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. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Double-wall round and flat-oval ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.
8. Seismic-restraint devices.

B. Related Sections:

1. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
2. Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal 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.

1. Static-Pressure Classes:

a. Supply Ducts (except in Mechanical Rooms): 2-inch wg.
b. Supply Ducts (Upstream from Air Terminal Units): 3-inch wg.
c. Supply Ducts (Downstream from Air Terminal Units): 1-inch wg.
d. Supply Ducts (in Mechanical Equipment Rooms): 2-inch wg.
e. Return Ducts (Negative Pressure): 1-inch wg.
f. Exhaust Ducts (Negative Pressure): 1-inch wg.

2. Leakage Class:

a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
b. Flat-Oval Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
c. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.

d. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

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. Welding certificates.

C. Field quality-control reports.

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.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

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 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," 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."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," 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."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct) of the inner duct.

B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," 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."

a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," 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."

a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

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 A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, 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.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F 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. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

4. Duct insulation shall have a minimum R value = 5 for installation in an unconditioned space, and a minimum R value = 8 for installation outdoors.

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 with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
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. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 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. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. 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, "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 A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

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. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 15 Section "Duct Accessories" for fire and smoke dampers.

L. 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 SEAM AND JOINT SEALING

A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C, except as follows:

a. Ducts that are located directly in zones they serve.

3.3 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 or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "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.

3.4 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 15 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."
2. Test the following systems:

   a. Supply air.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before insulation application.
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 entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. 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.

3.6 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 15 Section "Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.7 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel:

B. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts: Galvanized steel.
3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

C. Liner:

1. Supply- and Return-Air Ducts: Fibrous glass, Type I.

D. Double-Wall Duct Interstitial Insulation:

1. Supply- and Return-Air Ducts: 1 inch thick.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 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."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 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) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.

2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

F. 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.

G. Duct Schedule

1. Rectangular duct with liner:

a. Low pressure supply and return.

2. Rectangular duct wrapped with insulation:

a. Low pressure exhaust and fresh air.

3. Single wall round with wrapped insulation.

a. Low pressure supply and return.

4. Double wall round and flat oval:

a. Medium pressure supply (upstream of VAV).

END OF SECTION 15815

SECTION 15820 - DUCT ACCESSORIES

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. Backdraft dampers.
2. Volume dampers.
3. High Efficiency Take-Offs.
4. Combination fire and smoke dampers.
5. Turning vanes.
6. Duct-mounting access doors.
7. Flexible connectors.
8. Flexible ducts.
9. Duct accessory hardware.

B. Related Sections include the following:

1. Division 15 Section "HVAC Instrumentation and Controls" for electric and pneumatic damper actuators.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Backdraft dampers.
2. Volume dampers.
3. High Efficiency Take-Offs.
4. Combination fire and smoke dampers.
5. Turning vanes.
6. Duct-mounting access doors.
7. Flexible connectors.
8. Flexible ducts.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 SHEET METAL 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.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT DAMPERS

A. Description: Multiple-blade, parallel action gravity balanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

B. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.

C. Blades: 0.025-inch- thick, roll-formed aluminum.

D. Blade Seals: Neoprene.

E. Blade Axles: Galvanized steel.

F. Tie Bars and Brackets: Galvanized steel.

G. Return Spring: Adjustable tension.

2.3 VOLUME DAMPERS

A. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

B. Standard Volume Dampers: Opposed-blade design, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
3. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
4. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
5. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
6. Blade Axles: Galvanized steel.
7. Bearings: Oil-impregnated bronze.
8. Tie Bars and Brackets: Aluminum.
9. Tie Bars and Brackets: Galvanized steel.

C. Damper Hardware: 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. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 HIGH EFFICIENCY TAKE-OFF

A. Factory-manufactured rectangular-to-round or round-to-round 45 degree leading tap fabricated of 24 ga zinc-coated lockforming quality steel sheets meeting requirements of ASTM A 653, with G-90 coating.

B. One inch wide mounting flange with die formed corner clips, pre-punched mounting holes, and adhesive coated gasket.

C. Manual Volume Damper:

1. Single blade, 22 ga minimum.
2. 3/8 inch minimum square rod with brass damper bearings at each end.
3. Heavy duty locking quadrant on 1-1/2 inch high stand-off mounting bracket attached to side of round duct.

2.5 COMBINATION FIRE AND SMOKE DAMPERS

A. General Description: Labeled according to UL 555S. Combination fire and smoke dampers shall be labeled according to UL 555 for 1-1/2-hour rating.

B. Fusible Links: Replaceable, 165 deg F rated.

C. Frame and Blades: 0.064-inch- thick, galvanized sheet steel.

D. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.

E. Damper Motors: Modulating and two-position action.

1. Comply with requirements in Division 15 Section "Motors."

2. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
3. 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.
4. Outdoor Motors and Motors in Outside-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.
5. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
6. Electrical Connection: 115 V, single phase, 60 Hz.

2.6 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.7 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
2. Provide number of hinges and locks as follows:

a. Less Than 12 Inches Square: Secure with two sash locks.
b. Up to 18 Inches Square: Two hinges and two sash locks.
c. Up to 24 by 48 Inches: Three hinges and two compression latches.
d. Sizes 24 by 48 Inches and Larger: One additional hinge.

C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

D. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.8 FLEXIBLE CONNECTORS

A. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

B. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.

C. 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.

D. 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.

2.9 FLEXIBLE DUCTS

A. Insulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.

B. Flexible Duct Clamps: Nylon strap, in sizes 3 through 18 inches to suit duct size.

2.10 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 APPLICATION AND INSTALLATION

A. 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.

B. Provide 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.

C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

F. Provide test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.

H. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:

1. On both sides of duct coils.
2. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
3. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
4. On sides of ducts where adequate clearance is available.

I. Install the following sizes for duct-mounting, rectangular access doors:

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.

J. Install the following sizes for duct-mounting, round access doors:

1. One-Hand or Inspection Access: 8 inches in diameter.
2. Two-Hand Access: 10 inches in diameter.
3. Head and Hand Access: 12 inches in diameter.
4. Head and Shoulders Access: 18 inches in diameter.
5. Body Access: 24 inches in diameter.

K. Label access doors according to Division 15 Section "Mechanical Identification."

L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

M. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands.

Q. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 15820

SECTION 15838 - EXHAUST FANS

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. Centrifugal roof ventilators.
2. Ceiling Mounting Ventilator.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

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. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. 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. Field quality-control test reports.

D. Operation and Maintenance Data: For power ventilators 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, 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.

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 3.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 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: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. 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.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. 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.

E. 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.
4. Spring loaded, automatic belt tensioning pulley.

F. 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: Built-in cant and mounting flange.
2. Overall Height: 12 inches.
3. Sound Curb: Curb with sound-absorbing insulation matrix.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.
6. Mounting Pedestal: Galvanized steel with removable access panel.
7. Vented Curb: Unlined with louvered vents in vertical sides.

G. Capacities and Characteristics: See drawings.

2.2 CEILING-MOUNTING VENTILATORS

A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories:

1. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
2. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
3. Motion Sensor: Motion detector with adjustable shutoff timer.
4. Manufacturer's standard roof jack or wall cap, and transition fittings.

G. Capacities and Characteristics: See drawings.

2.3 MOTORS

A. Enclosure Type: Totally enclosed, fan cooled.

2.4 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 restrained spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops Insert device having a static deflection of 1 inch. Vibration-control devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 15 Section "Mechanical Identification."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."

D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

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 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 15838

SECTION 15855 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections include the following:

1. Division 15 Section "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 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.

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. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 GRILLES AND REGISTERS

A. Adjustable Bar Side Wall Supply Grille:

1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: Adjustable horizontal spaced 1/4 inch apart.
4. Frame: 1 inch wide.

B. Fixed Face Ceiling Return, Exhaust, or Transfer Air Grille:

1. Material: Steel.
2. Finish: Baked enamel, white.
3. Face Arrangement: 1/2 inch horizontal blade spacing.
4. Frame: 1-1/4 inches wide.

C. Low Sidewall Return Grilles

1. Finish – Standard white baked enamel.
2. Zero degree deflection.

2.3 CEILING DIFFUSER OUTLETS

A. Round Ceiling Diffuser Duct Mounted Exposed:

1. Material: Heavy gauge spun steel.
2. Finish: Baked enamel, color selected by Architect.
3. Face Style: Three cone.
4. Pattern: Two position horizontal.

B. Rectangular and Square Ceiling Diffusers:

1. Material: Steel.
2. Finish: Baked enamel, white.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, provide lay-in ceiling module. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 15855

SECTION 15887 - LOUVERS

PART 1 - GENERAL

1.1 SCOPE

A. Provide and install louvers as shown on the drawings.

PART 2 - MATERIALS

2.1 MECHANICAL LOUVERS

A. Extruded aluminum, with blades welded or screwed into frames and 1/2 inch mesh 16 gauge aluminum bird screen.

B. Frames shall have mitered corners.

C. Louvers shall be recessed, flanged, stationary, or removable as noted on drawings.

D. Finish -

1. Polyvinyledene Fluorise (PVF2) resin-base finish (Kynar 500 or Hylar 5000) for coil coating componenets contailing 70% minimum PVF2 in resin portion of formula. Thermo cured two coat system consisting of corrosion inhibiting epoxy or acrylic latex primer and top ocat facotry applied over properly pretreated metal.
2. Color as selected by Architect from Manufacturers standard colors.

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. 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 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. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. 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.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

D. Restore louvers 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.

E. 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 15887

SECTION 15950 - TESTING, ADJUSTING, AND BALANCING

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 TAB to produce design objectives for the following:

1. Air Systems:

   a. Constant-volume air systems.
   b. Variable-air-volume systems.

2. HVAC equipment quantitative-performance settings.
3. Existing systems TAB.
4. Verifying that automatic control devices are functioning properly.
5. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. TAB: Testing, adjusting, and balancing.

N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

O. Test: A procedure to determine quantitative performance of systems or equipment.

P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

E. Sample Report Forms: Submit two sets of sample TAB report forms.

F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.
b. The Contract Documents examination report.

c. TAB plan.
d. Danis Test and Balance
e. Work schedule and Project-site access requirements.
f. Coordination and cooperation of trades and subcontractors.
g. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

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.

1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine system pumps to ensure absence of entrained air in the suction piping.

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

R. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

S. 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 system readiness 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 Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, 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 outside-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. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable 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 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.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
6. 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 modes 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 static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

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. 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 terminal 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 terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point 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 outside-air dampers at minimum, and 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 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 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 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 outside airflow. Adjust the fan and balance the return-air ducts and inlets 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 the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.

5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR 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.
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.
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 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. 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.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. 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.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
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 for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each 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. Refrigerant Coils: Measure the following data for each 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.

3.14 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.15 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
4. Air balance each air outlet.

3.16 PROCEDURES FOR TESTING DUCT SYSTEMS

A. Perform duct leakage tests and duct cleanliness tests as described in section 15815.

B. Duct system will be considered defective if it does not pass initial tests and inspections. The sheet metal contractor shall be responsible to make corrections and repairs as necessary to pass the tests. TAB contractor shall include initial test and 1 follow up test. Any additional follow up tests required due to system not passing shall be performed by the TAB contractor at the Division 15 contractor's expense.

3.17 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.18 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Heating-Water Flow Rate: 0 to minus 10 percent.
4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.19 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.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.20 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Provide final report on standard AABC or NEBB forms.

3.21 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. Randomly 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. Measure sound levels at two locations.
e. Measure space pressure of at least 10 percent of locations.
f. Verify that balancing devices are marked with final balance position.
g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.22 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing 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 testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15950

SECTION 15970 - CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes but Not Limited To

1. Furnish and install office area automatic temperature control system as described in Contract Documents.
2. Furnish and install conductors and make connections to control devices and equipment.
3. Furnish and install raceway (conduit) for all control systems including low voltage wiring systems.

B. Related Sections

1. General Conditions, Division 01, and Section 15 055 apply to this Section.
2. Section 15055 - Instruction of Owner.
3. Section 15891 - Furnishing and installing of temperature control dampers.
4. Division 16 -
   a. Furnishing and installing of raceway (conduit) and junction boxes, including pull wires, for temperature control system except as noted above.
   b. Power wiring to magnetic starters, disconnect switches, and motors.
   c. Motor starters and disconnect switches, unless integral with packaged equipment.

1.2 SYSTEM DESCRIPTION

A. Performance Criteria

1. Install line and low voltage electrical wiring, raceway (conduit), and boxes in accordance with Division 16 of these Specifications. One-half inch conduit may be used for low voltage wiring systems.

1.3 SUBMITTALS

A. Shop Drawings

1. Provide three copies of shop drawing submittal data for review. See Section 01 340 for definitions and procedures.

B. Maintenance Data

1. Upon completion of work of this Section and prior to final inspection, schematics, catalog cuts, maintenance instructions, and written operating sequence for each boiler/fan coil system to be included in Operation & Maintenance Manual specified in Section 15055.

C. Project Record Documents

1. Provide two copies of record ATC diagrams.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Room Thermostats

1. 7 day programmable low voltage type provided with auto change over and two starts and stops per day, and provisions for damper operators.
2. Approved Manufacturer & Model
   a. Honeywell

B. Safety Controls

1. Ionization smoke detector mounted in supply air streams. Detector to operate on 24 volts AC.
2. Install on systems greater than 2000 CFM.
3.

C. Switching Sub-Base

1. "Fan selector switch" with ON-AUTO modes for each fan system

D. Transformer

1. 120/24 volt, 75VA Johnson Y66AUD-1 (foot mount)

E. Damper Actuators

1. Electric type equipped for Class I wiring.
2. Shall not consume power during UNOCCUPIED cycle and shall not use chemicals or expandable media.
3. Have built in spring return.
4.

F. Conductors

1. Color coded and #16 AWG Type TWN, TFN or THHN (stranded).
2. Thermostat Cable - 12 conductor or 8 conductor, 18AWG solid copper wire, insulated with high density polyethylene. Conductors parallel enclosed in brown PVC jacket (No 22 AWG cable allowed).

G. Carbon Monoxide Detector

1. Detector shall be fully electronic incorporating solid state circuitry with electronic board, factory calibrated at low of 35 PPM and high of 100 PPM CO levels. Electronic board shall incorporate visual indicators seen through unit cover for

power on, operating status and sensor trouble functions.

2. The circuitry shall force the “LOW” CO level operating relay to energize a sensor trouble condition so that the fans will run until trouble is corrected.
3. The electronic board shall incorporate a microprocessor controlled automatic sensing element decontamination program which is repeated at fixed short intervals to remove water vapor and other miscellaneous contaminates.
4. The LOW CO operating level shall close an independent SPDT contact with visual status indicator on unit.
5. The HIGH CO operating level shall close another independent SPDT contact with additional visual indication on unit.
6. The HIGH CO level shall provide a visual and audible alarm. Nuisance alarms caused by temporary conditions shall be avoided by providing a 30-minute time delay between operation of high alarm levels.
7. Unit enclosure shall be gasketed, made of corrosion resistant PVC material with vandal proof cover screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Run conductors and thermostat cable in conduit. No exceptions.

B. Safety Controls

1. Mount smoke detector in return air duct of each heating system as shown on the Control Drawings and interlock to keep heating and cooling from operating if detector is energized.
   a. If it is physically impossible to mount smoke detector in return air duct, mount in mixed air plenum as close to return air duct as possible.
2. Interlock gas valves with supply air fan.
3. Gas valves shall obtain their electrical control power from same circuit as supply fan motor.

4. Check high limit thermostats furnished with heating equipment for correct operation. Gas valves shall close when duct thermpsature exceeds high limit setting. Perform this work immediately after wiring burner controls.
5. Bonnet thermostatic switches furnished with heating equipment shall be wired to dissipate all heat in combustion chambers.
6. Fresh air damper shall close on fan shut-down, power failure, open fan motor disconnect switch, and when thermostat is in UNOCCUPIED mode.
7. Gas burner safety controls furnished with furnace units shall be incorporated in control circuits for all modes of operation.

C. Mount remote room temperature sensors and CO detectors 4'6" from floor to bottom of sensor.

D. Mount damper actuators and actuator linkages external of air flow.

E. Provide fresh battery (Mallory MN1604 9 volt alkaline type or equal) in each thermostat

and instruct custodian in battery replacement.

3.2 FIELD QUALITY CONTROL

A. Field Service

1. Calibrate, adjust, and set controls for proper operation, operate systems and be prepared to prove operation of any part of control system. This work is to be completed before prefinal inspection.

3.3 ADJUSTING

A. Program minimum of one week operation into thermostat's memory function.

END OF SECTION 15970

SECTION 15985 - SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. Performance Requirements

1. System -
   a. Programmable thermostat shall control unoccupied and occupied status of fan system based on adjustable seven day program. Fan shall cycle in unoccupied and occupied modes.
   b. Auxiliary fan cycle switch is provided by thermostat sub-base and is to be used to cycle fan in occupied mode.
   c. Adjustable heating set points shall control space temperature by activating equipment, with automatic change over from heating to cooling.
   d. Thermostat provides optional override of thermostat program by allowing three hour timed override of thermostat program at any time by pushing selected point on thermostat cover. This shall activate thermostat to occupied mode and system shall control to occupied set point.
   e. Minimum outside air damper (spring return type) shall open in occupied mode and remain closed in unoccupied mode in zones using outside air. Damper shall be normally closed.

2. Radiant heating systems shall operate in response to heating only thermostat provided by the manufacturer.

3. Building ventilation system: shall operate with a wall mounted AUTO/ON switch. When switch is in the “ON” position it shall activate the exhaust fan, or wall mounted exhaust fan and ventilation louver damper shall go to the full open position When switch is in the “AUTO” position the fan and louver damper shall by operated by a carbon monoxide (CO) monitor. When the CO monitor detects carbon monoxide it shall activate the louver damper open and the exhaust fan on.

4. Restroom exhaust fan shall be energized by restroom light switch with adjustable fifteen minute shut-off delay timer.

END OF SECTION 15985

SECTION 16001 - ELECTRICAL GENERAL PROVISIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and ALL other sections of Division 16

B. Equipment requiring rough-ins and/or connections by Division 16 may be shown on the architectural drawings and/or specified in Sections 1 through 15 Division 16 is responsible for these rough-ins and/or connections whether shown on the electrical drawings or not.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for electrical installations.
1. Product Substitutions.
2. Coordination Drawings.
3. Record Drawings and documentation.
4. Delivery, storage and handling.
5. Rough-ins
6. Electrical installations.
7. Cutting and patching.

1.3 PRODUCT SUBSTITUTIONS

A. Substitutions will be considered by submitting a duplicate written application (2-copies) to the offices of the Architect and Engineer five (5) working days prior to the day of the bidding. The application shall include:
1. A statement certifying that the proposed equipment proposed is equal to that specified; that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents.
2. The specified and submittal catalog numbers of the equipment under consideration;
3. A pictorial and specification cut sheet or brochure.

B. All conflicts that arise from the use of substituted equipment shall be the responsibility of the Contractor, who shall bear all costs required to make the equipment comply with the intent of the contract documents or replace equipment with specified products.

1.4 SHOP/COORDINATION DRAWINGS

A. Prepare shop/coordination drawings which include product data cut sheets, performance data, wiring diagrams, dimensions, spatial/maintenance needs, etc along with 1/8” or larger detailed shop drawings as applicable denoting electrical equipment and materials in relationship with other systems, installations and building components. Coordinate with Division 15. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including but not limited to the following:
1. Indicate the proposed locations of equipment, motor controllers, disconnects, duct smoke detectors, control panels and control devices. Include the following:

a. Control diagrams
b. Clearances for servicing and maintaining equipment and space for equipment disassembly required for periodic maintenance.
c. Equipment connections and support details
d. Exterior wall and foundation penetrations.
e. Fire rated wall and floor penetrations. (refer to architectural plans)
f. Sizes and locations of required concrete pads and bases.

2. Indicate scheduling, sequencing, movement and positioning of large equipment in the building during construction.
3. Prepare floor plans, elevations and details to indicate penetrations in floors, walls and ceilings and their relationship to other penetrations and installations.
4. Coordinate “Lighting Fixture Schedule closely with architectural reflected ceiling plans. If device types shown on the electrical plans conflict with the architectural reflected ceiling plans, Architect shall be advised of discrepancies prior to fixture installation.

1.5 RECORD DRAWINGS/DOCUMENTS

A. Prepare record documents that indicate the following installed conditions.
1. Equipment locations dimensioned from prominent building lines.
2. Approved substitutions, Contract modifications and actual equipment and materials installed.
3. Contract modifications , actual equipment and materials installed.
4. All circuit designations as installed.
5. All underground electrical lines.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades compliance labels and other information needed for identification.

B. Handle carefully to prevent damage. Following manufacture’s written instructions foe rigging. Replace damaged products.

C. Store in clean dry place off the ground. Protect from weather, water and physical damage.

PART 2 PRODUCTS

A. Products are as specified by manufacturer name, description, and/or catalog number. Discrepancies between equipment specified and the intended function of equipment shall be brought to the attention of the Architect/Engineer in writing prior to bidding. Failure to report any conflict, including catalog numbers, discontinued products, etc., does not relieve the Contractor from meeting the intent of the contract documents nor shall it change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specifications, or should he find discrepancies therein, he shall bring this to the attention of the Architect/Engineer who will issue interpretation and/or additional instructions to Bidders before the project is bid.

B. Manufacturers: Furnish and install electrical products from manufacturers as specified or accepted through methods specified here-in. The manufacturer’s descriptions and catalog numbers are to establish basic product quality required. Substitutions will be considered by submitting a duplicate written application (2-copies) to the offices of the

Architect and Engineer five (5) working days prior to the day of the bidding. The application shall include the following: 1) A statement certifying that the equipment proposed is equal to that specified; that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents; 2) The specified and submittal catalog numbers of the equipment under consideration; 3) A pictorial and specification brochure.

C. Any conflict arising from the use of substituted equipment shall be the responsibility of the Contractor, who shall bear all costs required to make the equipment comply with the intent of the contract documents.

D. Samples may be required for non-standard or substituted items before installation during construction. Provide all samples as required.

E. No materials or apparatus may be substituted after the bid opening except where the equipment specified has been discontinued.

F. Provide only equipment specified in the Contract Documents or approved by addendum.

G. Provide spare parts (fuses, diffusers, lamps, etc.) as specified. Transmit all spare parts to Owner's Representative prior to substantial completion.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements, equipment requiring rough-in by Division 16 may be specified in sections other the Division 16.

C. Refer to architectural, civil, mechanical, security, telecommunications, kitchen, laundry etc drawings for equipment not shown on the Division 16 drawings that may require electrical connections by Division 16.

3.2 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate and integrate the various elements of electrical systems, materials and equipment. Comply with the following requirements:
1. Coordinate electrical systems, equipment and materials installations with other build components.
2. Verify all dimensions by field measurement.
3. Arrange for chases, slots and openings in other building components during progress of construction, to allow for electrical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in place concrete and other structural components, as they are constructed.
5. Coordinate the installation of 4” concrete housekeeping pads for all floor mounted electrical equipment. Pads shall be 4” deep and 6” larger in each dimension than the equipment. Concrete requirements are as specified in Division 3.

6. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of work. Give particular attention to large equipment requiring positioning prior to closing in the building.
7. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible.
8. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.
9. Install systems, materials and equipment to conform with approved submitted data, including coordination drawings, to the greatest extent possible. Conform to arraignments indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual systems requirement, refer conflict to Engineer. Maintain manufacture's recommended clearances.
10. Install systems, materials level and plumb, parallel ad perpendicular to other building systems and components, where installed expose in finished spaces.
11. Install electrical equipment to facilitate servicing maintenance and repair of replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.
    a. Comply with working clearances identified in Article 110-26 2005 NEC and coordinate with Division 15 subcontractor to insure that no piping, ductwork or equipment is installed in the exclusively dedicated space for switchboards or panelboards within the scope of Article 384.

12 Install access panel or doors where equipment is concealed behind finished surfaces.

13 Install systems, materials and equipment giving right-of-way priority to systems required to be install at a specific slope.

14 All penetrations of fire rated partitions by electrical services shall be fire stopped as required by the specifications and local codes. Refer to architectural drawings for locations fo fire rated partitions.

3.3 DEMOSTRATIONS

A. Provide start-up services and instruct Owners personnel if operation and maintenance of major items of equipment.

B. Start-up equipment, only in accordance with manufacture's written instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

C. Train Owner's personnel on start-up and shut-down procedures, troubleshooting procedures, servicing ad preventive maintenance scheduled procedures. Review with Owner' personnel the data contained in the Operating and Maintenance Manuals specified in this specification.

3,4 CUTTING AND PATCHING

A. General: Perform all cutting and patching in accordance with Division 1.

3.5 CLEAN

A. Clean up all miscellaneous materials such as equipment, conduits, fittings, conductors, packing cartons and other debris that is a direct result of the installation of the work of this division.

B. Clean all lighting fixture, panelboard and switchboard interiors and exteriors of all dust and debris from enclosures and raceways. Replace filters in electrical equipment request for substantial completion.

3.6 DEMOSTRATIONS AND START-UP:

A Provide start-up services and instruct Owners personnel if operation and maintenance of major items of equipment.

B Start-up equipment, only in accordance with manufacture's written instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

C Train Owner's personnel on start-up and shut-down procedures, troubleshooting procedures, servicing ad preventive maintenance scheduled procedures. Review with Owner' personnel the data contained in the Operating and Maintenance Manuals specified in this specification.

END OF SECTION 16001

SECTION 16060 - GROUNDING AND BONDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Rod electrodes.
2. Wire.
3. Grounding well components.
4. Mechanical connectors.
5. Exothermic connections.
6. Concrete encased electrode (UFER ground)

B. Related Sections:
1. Section 02590 - Site Grounding: Site related grounding components for buildings and facilities.
2. Section 03200 - Concrete Reinforcement: Bonding or welding bars when reinforcing steel is used for electrodes.
3. Section 10270 - Access Flooring: Grounding systems for access flooring.
4. Section 13100 - Lightning Protection: Grounding of lightning protection system.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
3. NFPA 70 - National Electrical Code.
4. NFPA 99 - Standard for Health Care Facilities.

1.3 SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:

1. Metal underground water pipe.
2. Metal building frame.
3. Concrete-encased electrode. (UFER)
4. Metal underground gas piping system.
5. Rod electrode.
6. Plate electrode.
7. Separately derive system.

1.4 DESIGN REQUIREMENTS

A. Construct and test grounding systems for access flooring systems on conductive floors accordance with IEEE 1100. Refer to Architectural sections.

1.5 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms maximum.

1.6 SUBMITTALS

A. Product Data: Submit data on grounding electrodes and connections.

B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

C. Manufacturer's Installation Instructions:

1.7 CLOSEOUT SUBMITTALS

A. Submit test reports.

B. Project Record Documents: Record actual locations of components and grounding electrodes.

1.8 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

B. Perform Work in accordance with State Municipality of local code standards

1.9 COORDINATION

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

A. Manufacturers:
1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. O-Z Gedney Co.
5. Thomas & Betts, Electrical.

B. Product Description:
1. Material: Copper-clad steel.
2. Diameter: 3/4 inch.
3. Length:10 feet (3.0 m).

C. Connector: Connector for exothermic welded connection. Or grounding clamp.

2.2 WIRE

A. Material: Stranded copper.

B. Foundation Electrodes: UFER 2/0 AWG 30”-0”

C. Grounding Electrode Conductor: Copper conductor.

D. Bonding Conductor: Copper conductor.

2.3 GROUNDING WELL COMPONENTS

A. Well Pipe: 8 inches x 24 inches long concrete pipe with belled end.

B. Well Cover: Fiberglass with legend "GROUND" embossed on cover.

2.4 MECHANICAL CONNECTORS

A. Manufacturers:
1. Apache Grounding/Erico Inc.
2. Copperweld, Inc. Model
3. Erico, Inc.
4. ILSCO Corporation.
5. O-Z Gedney Co.
6. Thomas & Betts, Electrical.

2.5 EXOTHERMIC CONNECTIONS

A. Manufacturers:
1. Apache Grounding/Erico Inc
2. Cadweld, Erico, Inc.
3. Copperweld, Inc.
4. ILSCO Corporation.
5. O-Z Gedney Co.
6. Thomas & Betts, Electrical.

B. Product Description: Provide exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils, surface contaminants etc at connection points.

3.3 INSTALLATION

A. Install in accordance with IEEE 142, 1100.

B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.

C. Install grounding and bonding conductors concealed from view.

D. Install grounding well pipe with cover at each rod location rod locations as indicated on Drawings. Install well pipe top flush with finished grade.

E. Install 2/0 AWG bare copper wire in foundation footing as indicated on Drawings Ufer Ground.

F. Install grounding electrode conductor and connect to reinforcing steel in foundation footing as indicated on Drawings. Electrically bond steel together.

G. Bond together metal siding not attached to grounded structure; bond to ground.

H. Bond together reinforcing steel and metal accessories in pool and fountain structures.

I. Install ground grid under access floors as indicated on Drawings. Construct grid of 12 AWG bare copper wire installed on 24 inch centers both ways. Bond each access floor pedestal to grid.

J. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to under floor ground grid. Install 8 AWG bare copper bonding conductor.

K. Install isolated grounding conductor for circuits supplying electronic cash registers, personal computers and telephone equipment in accordance with IEEE 1100.

L. Install grounding and bonding in patient care areas to meet requirements of NFPA 99.

M. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

N. Connect to site grounding system. Refer to Section 02590.

O. Bond to lightning protection system. Refer to Section 13100 if installed.

P. Install continuous grounding using underground cold water system and building steel as grounding electrode. also, install artificial station ground by means of 2 driven rods or buried electrodes.

Q. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

R. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.

S. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

T. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.

U. Permanently attach equipment and grounding conductors prior to energizing equipment.

V. Install Work in accordance with State and local Municipality standards.

3.4 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements 01700 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground resistance testing in accordance with IEEE 142.

E. Perform leakage current tests in accordance with NFPA 99.

F. Perform continuity testing in accordance with IEEE 142.

G. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION 16060

SECTION 16070 - ELECTRICAL HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Firestopping relating to electrical work.
7. Firestopping accessories.
8. Equipment bases and supports.

B. Related Sections:
1. Section 03300 - Cast-In-Place Concrete: Product requirements for concrete for placement by this section.

1.2 REFERENCES

A. ASTM International:
1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

B. National Fire Protection Association:
1. NFPA 70 - National Electrical Code.

C. Underwriters Laboratories Inc.:
1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL - Fire Resistance Directory.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479, to achieve fire ratings of adjacent construction in accordance with FM UL.

B. Surface Burning: ASTM E84, UL 723 with maximum flame spread / smoke developed rating of 25/450.

C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to applicable code FM UL for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

C. Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of trapeze hangers hangers and supports.

F. Manufacturer's Installation Instructions:
1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with State and local Municipality standards.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years experience.

B. Installer: Company specializing in performing work of this section with minimum five years experience.

1.9 PRE-INSTALLATION MEETINGS

A. Section 01300 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. Erico-Caddy Manufacturing Company.
3. O-Z Gedney Co.
4. Substitutions: Per approval process

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F (85 degrees C). Self locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. B-Line Systems Model.
3. Midland Ross Corporation, Electrical Products Division.
4. Unistrut Corp.
5. Erico-Caddy.
6. Substitutions: Per approval requirements.

B. Product Description: Galvanized 12 gauge thick steel. With holes 1-1/2 inches on center.

2.3 SPRING STEEL CLIPS

A. Manufacturers:
1. Erico-Caddy

B. Per approval requirements.

2.4 SLEEVES

A. Furnish materials in accordance with State and local Municipality standards.

B. Sleeves for conduits Through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.

C. Sleeves for conduit Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers:
1. Thunderline Link-Seal, Inc.
2. NMP Corporation.
3. Substitutions: As per approval requirements.

B. Furnish materials in accordance with State and local Municipality standards.

C. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

A. Manufacturers:
1. Dow Corning Corp.
2. Fire Trak Corp.
3. International Protective Coating Corp.
4. 3M fire Protection Products.
5. Specified Technology, Inc.
6. Substitutions: Per approval.

B. Furnish materials in accordance with State and local Municipality standards.

C. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single or Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

D. Color: Dark gray or As selected from manufacturer’s full range of colors.

2.7 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:
1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.

4. Plywood or particleboard.
5. Alumina silicate fireboard.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:
1. Furnish UL listed products [or products tested by independent testing laboratory].
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing damming materials to arrest liquid material leakage.

D. Obtain permission from Architect/Engineer before using powder-actuated anchors.

E. Do not drill or cut structural members.

F. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:
1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors and preset inserts.
2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Provide expansion anchors and preset inserts.

6. Sheet Metal: Provide sheet metal screws.
7. Wood Elements: Provide wood screws.

B. Inserts:
1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:
1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
4. Support vertical conduit at every [other] floor.

3.4 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place intumescent coating in sufficient coats to achieve rating required.

F. Remove dam material after firestopping material has cured.

G. Fire Rated Surface:
1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
   c. Pack void with backing material.
   d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

2. Where cable tray, bus, cable bus, conduit, wireway, or trough, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

H. Non-Rated Surfaces:
1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
   c. Install type of firestopping material recommended by manufacturer.
2. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms or data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4” inches (100 mm) thick and extending 6 inches (150 mm) beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members formed steel channels. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Extend sleeves through floors 4 inches 100 mm above finished floor level. Caulk sleeves.

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk [airtight]. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

3.7 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements 01700 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

A. Section 01700 - Execution Requirements: Requirements for cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Requirements for protecting finished Work.

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION 16070

SECTION 16123 - BUILDING WIRE AND CABLE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes building wire and cable; nonmetallic-sheathed cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections.

1.2 REFERENCES

A. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:
1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
2. Stranded conductors for control circuits.
3. Conductor not smaller than 12 AWG for power and lighting circuits.
4. Conductor not smaller than 16 AWG for control circuits.
5. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet
6. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

B. Wiring Methods: Provide the following wiring methods:
1. Concealed Dry Interior Locations: Use only building wire , Type THHN/THWN or XHHW insulation, in raceway.
2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN XHHW insulation, in raceway.
3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN or XHHW insulation.
4. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN or XHHW in raceway.
5. Exterior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.
6. Underground Locations: Use only Type THHN/THWN or XHHW

1.4 DESIGN REQUIREMENTS

A. Conductor sizes are based on copper unless indicated as aluminum or "AL".

B. When aluminum conductor is substituted for copper conductor, size to match circuit requirements for conductor ampacity and voltage drop.

1.5 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit for building wire.

C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.

D. Test Reports: Indicate procedures and values obtained.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of components and circuits.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 10 years documented experience.

1.8 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.9 COORDINATION

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

C. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths adequate for connection and expansion.

PART 2 PRODUCTS

‘2.1 BUILDING WIRE

A. Manufacturers:
1. Diamond Wire & Cable Co.
2. Essex Group Inc.
3. General Cable Co.
4. Substitutions: Pre approval.

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper.

D. Insulation: 600 volt rating; thermoplastic material rated 75 degrees C.

E. Insulation: NFPA 70; Type THHN/THWN or XHHW insulation for feeders and branch circuits larger than 350 AWG]; Type TW, THHN/THWN insulation for feeders and branch circuits 250 AWG and smaller].

1.10 SERVICE ENTRANCE CABLE

A. Manufacturers:

1. Diamond Wire & Cable Co.
2. Essex Group Inc.
3. General Cable Co.
4. Substitutions: As per approval.

B. Conductor: Copper 600-Volt Rated.

C. Insulation: Type XHHW.

D.

1.11 WIRING CONNECTORS

A. Solderless Pressure Connectors:
1. Burndy

B. Spring Wire Connectors:
1. Ideal
2. Burndy
3. 3M

C. Compression Connectors:
1. Burndy
2. Ideal

PART 2 EXECUTION

2.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify interior of building has been protected from weather.

C. Verify mechanical work likely to damage wire and cable has been completed.

D. Verify raceway installation is complete and supported.

2.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

2.3 INSTALLATION

A. Route wire and cable to meet Project conditions.

B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

C. Identify [and color code] wire and cable under provisions of Section 16075. Identify each conductor with its circuit number or other designation indicated.

D. Special Techniques--Building Wire in Raceway:
1. Pull conductors into raceway at same time.

2. Install building wire 4 AWG and larger with pulling equipment.

E. Special Techniques - Cable:
1. Protect exposed cable from damage.
2. Support cables above accessible ceiling, using spring metal clips or [metal] [plastic] cable ties to support cables from structure [or ceiling suspension system]. Do not rest cable on ceiling panels.
3. Use suitable cable fittings and connectors.

F. Special Techniques - Wiring Connections:
1. Clean conductor surfaces before installing lugs and connectors.
2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
3. Tape un-insulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

G. Install solid conductor for feeders and branch circuits 10 AWG and smaller.

H. Install stranded conductors for branch circuits 10 AWG and smaller. However, when stranded conductors are used in lieu of solid, then install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.

2.4 WIRE COLOR

A. General
1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
   a. Black and red for single phase circuits at 120/240 volts.
   b. Black, red, and blue for circuits at 120/208 or 120/240 volts single or three phase.
   c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
   a. Black and red for single phase circuits at 120/240 volts.
   b. Black, red, and blue for circuits at 120/208 or 120 240 volts single or three phase.
   c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.

B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.

C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:
   1. For 6 AWG and smaller: Green.
   2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

2.5 FIELD QUALITY CONTROL

A. Quality Requirements: Testing and inspection services. Execution Requirements: Testing, adjusting, and balancing].

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION 16123

SECTION 16129 - GUTTERMELT ROOF - GUTTER HEAT TRACE SYSTEM SELF REGULATING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish a complete UL Listed or CSA Certified system of heating cables, components, and controls, specifically for keeping water drainage paths clear and to avoid ice dams on roof eaves, gutters, and downspouts.

B. Related Sections:
   1. Section 073100 - Shingles and Shake: Installation coordination with roofing material and details
   2. Section 073200 - Roof Tiles: Installation coordination with roofing material and details.
   3. Section 074100 - Roof Panels: Installation coordination with roofing material and details.
   4. Section 075000 – Membrane Roofing: Installation coordination with gutter material and details.
   5. Section 076000 – Flashing and Sheet Metal: Installation coordination with gutter material and details.
   6. Section 077000 – Roof and Wall Specialties and Accessories: Installation coordination with gutter material and details.
   7. Section 260600 – Schedules for Electrical: Materials and installation of wiring and electrical power source.

1.2 SYSTEM DESCRIPTION

A. The self-regulating cable shall consist of two (2) 16 AWG nickel-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field. A radiation-cross-linked, modified polyolefin dielectric jacket shall cover the heating cable. To provide a ground path and to enhance the heating cable's ruggedness, the heating cable shall have a braid of tinned copper (-C), as required per section 427-23 of the NEC-2011. An ultraviolet stabilized weatherproof over jacket composed of: modified polyolefin shall cover the grounding braid. The cable shall be suited for use on concrete, wood, plastic, and asphalt building materials.

B. For energy efficiency and in order to provide heat output that is sufficient for deicing the heating cable shall have a nominal rating, in correlation with selection of the heating cable, of 9, or 12 watts per lineal foot in water at 32ºF.

A. The heating cable shall operate on line voltages of (select: 120, 208, 220, 240, or 277) volts.

B. The heating cable shall be Gutter-Melt® SR heating cable supplied by Heatizon Systems.

C. Power connection, end seal, and splice kit components shall be applied in the field.

D. A ground-fault equipment protection device shall protect heating cable circuit as required by Article 426 of the NEC-2011.

1.2 ELECTRICAL CODES AND STANDARDS

A. The entire design and installation of the Heatizon Gutter Melt® SR Cable System shall comply with the Manufacture’s Installation Manual.

B. National Electrical Code (NEC) for US installations; Canadian Standards Association (CSA) for Canadian Installations. (current editions).

C. Requirements of the "Authority Having Jurisdiction".

D. All Gutter Melt® SR Cable Heaters shall be approved to CSA and UL Standards as part of the system for keeping water drainage paths clear and to avoid ice dams on roof eaves, gutters, and downspouts.
   1. Constant Wattage cables are not acceptable for this application.
   2. Cables not able to withstand maximum exposure temperature of 149ºF (65ºC) are not acceptable for this application.

E. Enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. In order to ensure the most reliable electrical connection and to simplify the maintenance and troubleshooting of freeze protection systems only crimp connections are acceptable.

1.4 SUBMITTALS

A. Product Data: Submit manufacturers technical product data and written installation instructions for the Gutter Melt SR cable system.
B. Shop Drawings: At architect's request, submit drawings showing layout of system relay panel, activation device, grounding connections, and heating cables required to provide complete operating system. Including the following:
   1. Locations for activation devices.
   2. Locations of relay panel, junction boxes, feeder wires, and load wires.
   3. Circuit feeder runs from relay panel / junction box to heating element connection points.
   4. Connection points between circuit feeders and heating element.
   5. Wiring between relay panel and activation device.
   6. Location of aerial or pavement mounted temperature moisture sensor(s).
   7. Differentiate between:
      a. Control wiring.
      b. Heating element.
      c. Cold Lead.
      d. Branch-circuit wiring.
   8. Differentiate between zones of heating element.

C. Operation and Maintenance Data: Submit manufacturer's written maintenance and operation instructions for system.

D. Warranty: Submit copy of system manufacturer's standard warranty for system.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Firm regularly engaged in manufacturing of electric cable heating elements, of type, sizes, and ratings required, whose products have been in satisfactory use in similar services for not less than five years.

B. Installer Qualifications:
   1. Licensed Electrical Contractor with a minimum of two years successful certified experience installing projects utilizing electric heating cable systems equal to systems specified in this section.

C. Regulatory Requirements:

1. Comply with applicable local electrical code requirements of local authorities having jurisdiction.
2. Provide products that are listed recognized and labeled by Nationally Recognized Testing Laboratory (NRTL) that includes, but not limited to :
   a. ETL subsidiary of Intertek Testing Laboratories,
   b. Canadian Standards Association (CSA), and
   c. Underwriters Laboratories (UL).
3. Conform to requirements of "Standard for Electric Space Heating Cables" (UL – 1673, 2nd Edition, dated May 30, 1996).

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle in accordance with manufacturer's written instructions. Store materials in dry indoor location off the ground.

B. Remove damaged materials from job site and replace with new at no additional cost to owner.

1.7 WARRANTY

A. Provide the Manufacturer Standards with following requirements:
   1. Gutter Melt® SR Cable heating element – Ten year
   2. Relay panel and Activation device – One year

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Heatizon Systems, 4137 South 500 West, Murray, Utah 84123 (877) 877-4724 www.warmquest.com Contact: Shawn Wright (Sales Representative)

2.2 COMPONENTS

A. Heating element
   1. Gutter Melt® SR Cable shall be supplied by Heatizon Systems (Tel: 888-239-1232, Fax: 801-293-3077)
   2. Shall consist of two (2) 16 AWG nickel-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field. A radiation-cross-linked, modified polyolefin dielectric jacket shall cover the heating cable. To provide a ground path and to enhance the heating cable's ruggedness, the heating cable shall have a braid of tinned copper (-C), as required per section 427-23 of the NEC-2011. An ultraviolet stabilized weatherproof over-jacket composed of: modified polyolefin shall cover the grounding braid. The cable shall be suited for use on concrete, wood, plastic, and asphalt building materials.
   3. For energy efficiency and in order to provide heat output that is sufficient for snow melting, the heating cable shall have a nominal rating, in correlation with selection of the heating cable, of 5, 9, or 12 watts per lineal foot in Ice Water @ 32ºF.
   4. The heating cable shall operate on line voltages of (select: 120, 208, 220, 240, or 277) volts.
   5. Power connection, end seal, and splice kit components shall be supplied by Heatizon Systems and applied in the field.
   6. A ground-fault device for equipment protection, rated at 30-mA trip, shall protect heating cable circuit. This requirement is in accordance with Article 426 of the NEC-2011.

B. Relay Panel

1. Heatizon Relay Panel
   a. M330 – Relay Panel accommodating 4 circuits to be used to join multiple circuits in conjunction with the same activation scheme.

C. Activation
1. All Gutter Melt® SR Cable circuits shall be activated by a Heatizon Systems approved activator for Gutter Melt® SR Cable:
   a. Manual Control: The system shall be controlled by a switch, either directly or through and appropriate contactor.

   b. Snow Switch Control: An automatic snow/ice sensor (preferred) which detects precipitation occurring at temperatures below 38° F (4 ° C). Example Models: M332 / M326A / M326ARS

   c. Thermostatic Control: The system shall be controlled by a 0-255ºF adjustable ambient sensing thermostat. The thermostat shall be supplied with a 40º setting from the factory. The thermostat shall be type RTAS as supplied by Heatizon Systems.

   d. Multiple Circuits for Control, Monitoring and Power Distribution: Where the rating of the activator would be exceeded, it shall be used in conjunction with a Heatizon Relay Panel (M330) for activation of multiple heater circuits.

   e. If Gutter Melt® is operating in conjunction with Heatizon Roof Melt system than Heatizon Relay Panel can be activated by Heatizon Roof Melt Selector Box Model M329. This enables the Heatizon Roof Melt System to activate Gutter Melt® system jointly.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas where heating element is to be installed for proper installation, cleanliness, or condition that may hinder successful installation of Gutter Melt® SR cable system.
   1. Notify Contractor in writing of items needing correction.
   2. Do not install Gutter Melt® SR cable system until faulty conditions are corrected.

3.2 INSTALLATION

A. Interface with Other Work: Coordinate installation of Gutter Melt® SR cable system with appropriate sections of Division 26 Electrical.

B. The current Heatizon Gutter Melt® SR Cable Installation Manual shall be considered as part of this specification.

C. The heating cable shall be laid in gutters with 2 runs of Gutter Melt® per lineal foot of gutter; shall be suspended in downspouts with 2 runs of Gutter Melt® per vertical foot of downspout and held in place by a downspout hanger/s; and shall be attached to the roof using the roof clip.

D. All terminations shall be protected from the weather and from physical damage and bonded to the system ground.

E. The heating cable shall be protected from damage and installed according to manufacturer's instructions.

F. Any field alternations or deviations shall proceed only after authorization has been issued by engineer. All changes shall be accurately recorded by the contractor and shall be turned over to the engineer upon completion of the heating system scope of work.

3.3 FIELD QUALITY CONTROL

A. Testing as directed by system manufacturer.
   1. Field testing of insulation resistance and continuity of the units shall be carried out with a 2500VDC Megohmmeter insulation tester and recorded by the Electrical Contractor.
   2. Testing shall be performed by the Electrical Contractor done in the following order:
      a. Prior to Installation of Gutter Melt® SR Heating Cable (when removed from package).
      b. After Installation of Gutter Melt® SR Heating Cable on roof, gutters, drains, or downspouts.

3.4 RESISTANTANCE RECORDING

A. Insulation resistance shall be consistently not less than 20 megohms during each test.

B. A complete system startup shall be performed to verify successful operation.

C. Resistance readings shall be recorded in the Gutter Melt® SR Cable Design and Installation Manual

3.5 DEMOSTRATION

Provide adequate demonstration and training to Owner in operation and maintenance of system.

END OF SECTION 16129

SECTION 16130 - RACEWAY AND BOXES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and hand holes.

B. Related Sections:

1. Section 02581 - Underground Ducts and Manholes.
2. Section 16132 - Indoor Service Poles.
3. Section 16133 - Cable Trays.
4. Section 16134 - Underfloor Raceway Assemblies.
5. Section 16141 - Floor Boxes.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).

B. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Underground outside Foundation Wall: Provide rigid steel conduit, intermediate or thick wall nonmetallic conduit. Provide cast metal boxes or nonmetallic boxes.

C. In or Under Slab on Grade: Provide rigid steel conduit, intermediate metal conduit, plastic coated conduit, thick wall nonmetallic conduit.

D. Outdoor Locations, Above Grade: Provide rigid steel and conduit.

E. In Slab Above Grade: Provide electrical metallic tubing or thick wall nonmetallic conduit.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: **¾ inch** unless otherwise specified.

1.5 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate installation of outlet boxes for equipment connected under Section 16150.

C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:
1. Carlon Electrical Products.
2. Hubbell Wiring Devices.
3. Thomas & Betts Corp.
4. Walker Systems Inc.
5. The Wiremold Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. Rigid Aluminum Conduit: ANSI C80.5.

D. Intermediate Metal Conduit (IMC): Rigid steel.

E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 FLEXIBLE METAL CONDUIT

A. Manufacturers:
1. Carlon Electrical Products.
2. Hubbell Wiring Devices.
3. Thomas & Betts Corp.
4. The Wiremold Co.

2.3 WIREWAY

A. Manufacturers:
1. Carlon Electrical Products.
2. Hubbell Wiring Devices.
3. Thomas & Betts Corp.
4. The Wiremold Co.

B. Product Description: General purpose Oiltight and dust-tight Raintight] type wireway.

C. Knockouts: Manufacturer's standard.

D. Size: 4 x 4 inch (100 x 100 mm) 6 x 6 inch (150 x 150 mm) 8 x 8 inch (200 x 200 mm) 12 x 12 inch (300 x 300 mm)]; length as indicated on Drawings.

E. Cover: Hinged cover.

F. Connector: Flanged.

G. Fittings: Lay-in type with removable top, bottom, and side; captive screws.

H. Finish: Rust inhibiting primer coating with gray enamel finish.

2.4 OUTLET BOXES

A. Manufacturers:
1. Carlon Electrical Products.
2. Hubbell Wiring Devices.
3. Thomas & Betts Corp.
4. The Wiremold Co.

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch (13 mm) male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

C. Nonmetallic Outlet Boxes: NEMA OS 2.

D. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs as required.

E. Wall Plates for Finished Areas: As specified in Section 16140.

F. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.5 PULL AND JUNCTION BOXES

A. Manufacturers:
1. Carlon Electrical Products.
2. Hubbell Wiring Devices.
3. Thomas & Betts Corp.
4. The Wiremold Co.

B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

C. Hinged Enclosures: As specified in Section 16131.

D. Surface Mounted Cast Metal Box: NEMA 250, Type 4, 4X or 6; flat-flanged, surface mounted junction box:
1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

E. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
1. Material: Galvanized cast iron.

2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
3. Cover Legend: "ELECTRIC".

F. Fiberglass Concrete composite Boxes: Die-molded, glass-fiber or concrete composite boxes:
1. Cable Entrance: Pre-cut 6 inch x 6 inch (150 mm x 150 mm) cable entrance at center bottom of each side.
2. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 INSTALLATION

A. Install Work in accordance with State or local Municipality standards.

B. Ground and bond raceway and boxes in accordance with Section 16060.

C. Fasten raceway and box supports to structure and finishes in accordance with Section 16070.

D. Identify raceway and boxes in accordance with Section 16075.

E. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.3 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Arrange raceway supports to prevent misalignment during wiring installation.

C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 16070 provide space on each for 25 percent additional raceways].

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Construct wireway supports from steel channel specified in Section 16070.

H. Route exposed raceway parallel and perpendicular to walls.

I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

J. Route conduit in and under slab from point-to-point.

K. Maximum Size Conduit in Slab Above Grade: 3/4 inch. Do not cross conduits in slab.

L. Maintain clearance between raceway and piping for maintenance purposes.

M. Maintain 12 inch (300 mm) clearance between raceway and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

N. Cut conduit square using saw or pipe cutter; de-burr cut ends.

O. Bring conduit to shoulder of fittings; fasten securely.

P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

Q. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than 2 inch.

S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

T. Install fittings to accommodate expansion and deflection where raceway crosses seismic control and expansion joints.

U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

X. Close ends and unused openings in wireway.

3.4 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings. Specified in section for outlet device.

B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented as specified in Section 16140.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.

F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches (150 mm) separation. Install with minimum 24 inches (600 mm) separation in acoustic rated walls.

H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

I. Install stamped steel bridges to fasten flush mounting outlet box between studs.

J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

K. Install adjustable steel channel fasteners for hung ceiling outlet box.

L. Do not fasten boxes to ceiling support wires or other piping systems.

M. Support boxes independently of conduit.

N. Install gang box where more than one device is mounted together. Do not use sectional box.

3.5 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with other Section.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified.

C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings and reflected ceiling plan.

D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.6 ADJUSTING

A. Section 01700 - Execution Requirements: Testing, adjusting, and balancing.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused openings in boxes.

3.7 CLEANING

A. Section 01700 - Execution Requirements: Final cleaning.

B. Clean interior of boxes to remove dust, debris, and other material.

C. Clean exposed surfaces and restore finish.

END OF SECTION 13130

SECTION 16140 - WIRING DEVICES GENERAL

PART 1 GENERAL

1.1 SUMMARY

A. Section includes wall switches; wall dimmers; receptacles; multi-outlet assembly; and device plates and decorative box covers.

B. Related Sections:
1. Section 16130 - Raceway and Boxes: Outlet boxes for wiring devices.
2. Section 16141 - Floor Boxes: Service fittings for receptacles installed on floor boxes.
3. Section 16141 - Floor Boxes: Poke-through receptacles.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA WD 1 - General Requirements for Wiring Devices.
2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's catalog information showing dimensions, colors, configurations and ratings etc.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 10 years experience.

1.5 EXTRA MATERIALS

A. Section 01700 - Execution Requirements: Spare parts and maintenance products.

B. Furnish 10 of each style, size, and finish wall plate.

PART 2 PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers:
1. Hubbell
2. Pass Seymour
3. Leviton
4. Substitutions: Per approval.

B. Single Pole Switch:
1. Hubbell Model HBL 1221
2. Pass Seymour Model 20ACI.
3. Leviton Model 1221.

C. Three-way Switch:
   1. Hubbell Model HBL 1223.
   2. Pass Seymour Model 20AC3.
   3. Leviton Model 1223

D. Four-way Switch:
   1. Hubbell Model HBL 1221 PL
   2. Pass Seymour Model 20AC-RDL
   3. Leviton Model 1221 PL

E. Color: White or as selected.

2.2 WALL SWITCHES

A. Product Description: NEMA WD 1, [Heavy-Duty] [General-Duty], AC only general-use snap switch.

B. Body and Handle: White – Thermal plastic or with toggle handle.

C. Indicator Light: Lighted handle type switch Separate pilot strap; red color.

D. Ratings:
   1. Voltage: 120 or 277volts, AC.
   2. Current: 20 amperes minimum.

E. Ratings: Match branch circuit and load characteristics.

2.3 WALL DIMMERS

A. Manufacturers:
   1. Leviton
   2. Lutron
   3. Pass Seymour

B. Product Description: NEMA WD 1; Semiconductor dimmer for incandescent lamps, Type as indicated on Drawings.

C. Body and Handle: White plastic with linear slide.

D. Voltage: 120 volts.

E. Power Rating: 600, 1000, 2000

F. Accessory Wall Switch: Match dimmer appearance.

2.4 RECEPTACLES

A. Duplex Convenience Receptacle:
   1. Hubbell Model HBL 5252
   2. Pass Seymour Model 5352
   3. Leviton Model 5362
   4. Substitutions: Per approval Requirements.

B. GFCI Receptacle:
1. Hubbell Model HBL 5252G
2. Pass Seymour Model 5352 GFI
3. Leviton Model 5362 GFI
4. Substitutions: Per approval Requirements.

C. Hospital Use Receptacle:
1. Hubbell Model 8300 HS
2. Pass Seymour Model 8300 X-SP
3. Substitutions: Requirements Not Permitted.

2.5 RECEPTACLES

A. Manufacturers:
1. Hubbell
2. Pass Seymour
3. Leviton

B. Product Description: NEMA WD 1, [Heavy-duty] [General-duty] general use receptacle.

C. Device Body: White nylon

D. Configuration: NEMA WD 6, type.

E. Convenience Receptacle: Type 5-20R.

F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.6 WALL PLATES

A. Manufacturers:
1. Hubbell
2. Pass Seymour
3. Leviton

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify outlet boxes are installed at proper height.

C. Verify wall openings are neatly cut and completely covered by wall plates.

D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install devices plumb and level.

B. Install switches with OFF position down.

C. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Install receptacles with grounding pole.

F. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.

G. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.

H. Use jumbo size plates for outlets installed in masonry walls.

I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 16130 to obtain mounting heights [as specified and] as indicated on drawings.

B. Install wall switch 48 inches 1.2 m above finished floor.

C. Install convenience receptacle 18 inches 450 mm above finished floor.

D. Install convenience receptacle 4 inches 100 mm above counter back splash of counter.

E. Install dimmer 48 inches 1.2 m above finished floor.

F. Coordinate installation of wiring devices with floor box service fittings provided under Section 16135.

3.5 FIELD QUALITY CONTROL

A. Quality Requirements: Testing and inspection services - Execution Requirements: Testing, adjusting, and balancing.

B. Inspect each wiring device for defects.

C. Operate each wall switch with circuit energized and verify proper operation.

D. Verify each receptacle device is energized.

E. Test each receptacle device for proper polarity.

F. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

A. Execution Requirements: Testing, adjusting, and balancing.

B. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

A. Execution Requirements: Final cleaning.

B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 16140

SECTION 16210 - ELECTRICAL UTILITY SERVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes arrangement with Utility Company for permanent electric service; payment of Utility Company charges for service; service provisions; and utility metering equipment.

1.2 SYSTEM DESCRIPTION

A. Utility Company: Rocky Mountain Power.

B. System Characteristics: 208/120 volts, Three phase, Four-wire, 60 Hertz.

C. Service Entrance: Underground from RMP pole to Pad Mounted Transformer and on to CT Cabinet with Meter on the building

D. Underground Service Provisions: Underground service entrance to building service entrance equipment.
1. Utility Raceway Connection: At Utility Company's pad-mounted transformer.
2. Utility Service-Entrance Conductor Connection: At Utility Company's pad-mounted transformer. Service-entrance equipment and metering equipment.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Submit Utility-Meter cabinets and bases.

C. All service entrance equipment such as meter main assemblies, service disconnects, pre-cast transformer pad/vault units etc.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Utility Company written requirements.

B. Maintain one copy of each document on site.

1.5 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.6 COORDINATION

A. Coordinate with utility company, relocation of overhead or underground lines interfering with construction. Where power lines are to be relocated, bill utility costs, directly to Owner.

B. Contact utility company regarding charges related to service installation.

C. <u>Utility charges for service installation will be paid by Owner and are not part of this contract.</u>

PART 2 PRODUCTS

2.1 UTILITY METERS

A. Furnished by Utility Company.

B. Product Description: Self-contained watt-hour meter with demand attachment, rated. 208/120 volts, three phase. Meters must meet power company standards.

2.2 UTILITY METER BASE

A. Furnished by Electrical Contractor

B. Product Description: Meter base continuous duty in accordance with power company standards

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify service equipment is ready to be connected and energized.

3.2 INSTALLATION

A. Install service rack and weatherhead at height in accordance with Utility Company requirements. Install drip loop in service conductors.

B. Install service entrance conduits to building service entrance equipment. Utility Company will connect service lateral conductors to service entrance conductors. Connect service lateral conductors to service entrance conductors.

C. Install Pre-cast concrete pad / vault for Utility Company transformer, in accordance with Utility Companies Requirements.

END OF SECTION 16210

SECTION 16265 - ADJUSTABLE FREQUENCY DRIVE

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification is to cover a complete Adjustable Frequency motor Drive (AFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. The drive shall be designed specifically for variable torque applications, and shall be designated “ACH400”. It is required that the drive manufacturer have an existing:
   1. Sales representative exclusively for HVAC products, with expertise in HVAC systems and controls.
   2. An independent service organization.

B. The drive and all necessary controls as herein specified shall be supplied by the drive manufacturer. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten years.

1.2 QUALITY ASSURANCE

A. Manufacturer:
   1. ABB
   2. Danfoss-Graham
   3. Toshiba

B. Referenced Standards:
   1. Institute of Electrical and Electronic Engineers (IEEE)
      a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
   2. Underwriters laboratories
      a. UL508C
   3. National Electrical Manufacturer’s Association (NEMA)
      a. ICS 7.0, AC Adjustable Speed Drives
   4. IEC 16800 Parts 1 and 2
   5. Lonmark
      a. Function profile variable speed motor drive: 6010

C. Testing:
   1. All printed circuit boards shall be completely tested and burned-in before being assembled into the completed AFD. The AFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized systems test (hot). The burn-in shall be at 104 °F (4□°C), at full rated load.
   2. All testing and manufacturing procedures shall be ISO 9001 certified.

D. Qualifications:
   1. AFDs and options shall be UL listed as a complete assembly.
   2. AFDs and options shall be UL listed as a complete assembly.
   3. AFDs and options shall be CE labeled as a component.

1.3 SUBMITTALS

A. Submittals shall include the following information:
   1. Outline Dimensions
   2. Weight

3. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion.
   a. The AFD manufacture shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the AFD manufacturer to ensure compliance with IEEE standard 519 (latest version), guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior to AFD installation.
   b. Prior to installation, the AFD manufacturer shall provide the estimated total harmonic distortion (THD) caused by the AFDs. The results shall be based on a computer aided circuit simulation of the total actual system, with information obtained from the power provider and the user.
   c. If the voltage THD exceeds 5%, the AFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.
   d. Detail data on phase converter for the well pump

1.4 WARRANTY

A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of manufacturer. The warranty shall include all parts, labor, travel time and expenses.

PART 2 – PRODUCTS

2.1 ADJUSTABLE FREQUENCY DRIVES

A. The adjustable frequency drives (AFDs) shall be solid state, with a Pulse Width Modulated (PWM) output. The AFD package as specified herein shall be enclosed in a NEMA 1 enclosure, completely assembled and tested by the manufacturer. The AFD shall employ a full wave rectifier (to prevent input line notching), Integral Line Reactor(s), Capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output switching device. The drive efficiency shall be 97% or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.

B. Specifications for the ACH400 3 HP to 400 HP at 480 volts and 2 to 100 HP at 240 volts:
   1. Input 380/415/440/460/480 VAC +/- 10%, 3 phase, 48-63 Hz or input 208/220/230/240 VAC +/- 10%, 3 phase, 48-63 Hz. Under voltage trip @ rated input -35%, Over voltage trip @ rated input +30%.
   2. Interrupt rating 65 kAIC, suitable for use on a circuit capable of delivering not more than 65,000 RMS symmetrical amps, 480 V maximum.
   3. Output Frequency 0 to 250 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.
   4. Environmental operating conditions: 0 to 4□°C, 0 to 3300 feet above sea level, less than 95% humidity, non-condensing.
   5. Enclosure shall be rated NEMA 1 or NEMA 12.

C. The adjustable frequency drive (AFD) will be LONMARK® certified and will incorporate all Mandatory and Optional Network Variables of the LONMARK Functional profile: Variable Speed Motor Drive: 6010

D. The following operating information displays shall be standard on the AFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of two operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
1. Output Frequency,
2. Motor Speed (RPM, %, or Engineering units),
3. Motor Current,
4. Calculated Motor Torque,
5. Calculated Motor Power (kW),
6. DC Bus Voltage,
7. Output Voltage,
8. Voltage input and output to motor
9. Phase converter alarm
10. Heatsink Temperature (0 F),
11. Analog Input Values,
12. Analog Output Value,
13. Keypad Reference Values,
14. Elapsed Time Meter (resettable),
15. kWh meter (resettable),
16. mWh meter,
17. Digital input status,
18. Digital output status.

E. The AFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alphanumeric codes are not acceptable).
1. Over current trip 350% instantaneous (170% RMS) of the AFD's variable torque current rating.
2. Over voltage trip 130% of the AFD's rated voltage.
3. Under voltage trip 65% of the AFD's rated voltage.
4. Over temperature +90° C, Heatsink Temperature.
5. Ground Fault either running or at start.
6. Adaptable Electronic Motor Overload (ft2). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependant, are unacceptable. The electronic motor overload protection shall be UL Listed for this function.

F. The Well pump AFD shall be provided complete with a phase converter for the 7-1/2 HP well pump as an integral part of the AFD. Converter to provide 3phase power the well pump motor from a 120/240volt single phase input.

G. Speed Command Input shall be via:
1. Keypad.
2. Two Analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal.
3. Floating point input shall accept a three-wire input from a Dwyer Photohelic (or equivalent type) instrument.
4. Lonworks Communications.

H. Serial Communications
1. The AFD shall have a Lonworks port as standard. The standard protocol shall be Modbus.
2. The AFD shall be able to communicate with other components via the Lonworks port.

3. Lonworks communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control (Set Point) adjustments, current limit, and accel/decel time adjustments.
4. Control inputs to be coordinated with control contractor for full range operation and limitations.

I. Optional Features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly.
1. Bypass Controller - Manual transfer to line power via contactors. Status LEDs to indicate the mode of operation drive and bypass status and ready & enable conditions. When in the “Drive” mode, the bypass contactor is open and the drive output contactor is closed. In the “Bypass” position, the drive output contactor is open, and the bypass contactor is closed via Start/stop command. Start/stop via customer supplied maintained contact shall be 24V or 115V compatible and shall function in both the “Drive” and “Bypass” modes. The voltage tolerance of the bypass power supply shall be +30/-35% to eliminate the problem of contactor coil burnout. The design shall include single-phase protection in both the AFD and bypass modes.
   a. Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, Drive or Bypass modes.
   b. Door / cover interlocked disconnect switch which will disconnect all input power from the drive, bypass and all internally mounted options. The disconnect handle shall be through the door, and be padlockable in the “Off” position.
   c. Fast acting semi-conductor fuses exclusive to the AFD – fast acting semi-conductor fuses allow the AFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs which have no such fuses, or that incorporate fuses common to both the AFD and the bypass will not be accepted. In such designs, a fuse clearing failure would render the bypass unusable.
   d. Class 20 or 30 (selectable) electronic motor overload protection shall be included in the microprocessor bypass to protect the motor in bypass mode.
2. Integral Input Reactors – equivalent 5% impedance. Note that the standard AFD includes 3% line reactor(s).
3. NEMA 12 Enclosure - The optional NEMA 12 enclosure shall be UL Listed as Plenum rated.
4. LonWorks option - The optional LonWorks board allows for 78 kBit/s Free Topology communications to LonWorks networks.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the AFD manufacturer as outlined in the installation manual.

B. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the AFD manufacturer as outlined in the installation manual.

3.2 START-UP

A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 PRODUCT SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with the ACH 400 drive products offered shall be locally available at both the specifying and installation locations.

3.4 WARRANTY

A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of manufacturer. The warranty shall include all parts, labor, travel time and expenses.

END OF SECTION

SECTION 16411 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes fusible and nonfusible switches.

B. Related Sections:
1. Section 16491 - Fuses.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA FU 1 - Low Voltage Cartridge Fuses.
2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 10 years documented experience.

PART 2 PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:
1. Square D
2. General Electric
3. Cutler Hammer
4. Siemens
5. Substitutions: as per approval.

B. Product Description: NEMA KS 1, Type HD or GD with externally operable handle interlocked to prevent opening front cover with switch in ON position], enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.

D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R
3. Industrial Locations: Type 4.

E. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

F. Furnish switches with entirely copper current carrying parts.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:
1. Square D
2. General Electric
3. Cutler Hammer
4. Siemens
5. Substitutions: as per approval.

B. Product Description: NEMA KS 1, Type HD GD with externally operable handle interlocked to prevent opening front cover with switch in ON position] enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from [steel finished with manufacturer's standard gray.
1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R.
3. Industrial Locations: Type 4.

D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

E. Furnish switches with entirely copper current carrying parts.

2.3 SWITCH RATINGS

A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

B. Short Circuit Current Rating: UL listed for [10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere)] [200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes)]. [200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere)].

PART 3 EXECUTION

3.1 INSTALLATION

A. Install enclosed switches plumb. Provide supports in accordance with Section 16070.

B. Height: 5 feet (1500 mm) to operating handle.

C. Install fuses for fusible disconnect switches. Refer to Section 16491 for product requirements.

D. Install engraved plastic nameplates in accordance with Section 16075.

E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

A. Quality Requirements: Testing and Inspection Services - Execution Requirements: Testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION 16411

SECTION 16421 - ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes manual and magnetic motor controllers in individual enclosures.

B. Related Sections:
1. Section 16491 - Fuses.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
5. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
6. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Test Reports: Indicate field test and inspection procedures and test results.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and ratings of enclosed controllers.

B. Operation and Maintenance Data: Submit Replacement parts list for controllers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years [documented] experience.

PART 2 PRODUCTS

2.1 MANUAL MOTOR CONTROLLER

A. Manufacturers:
   1. Siemens
   2. General Electric
   3. Square D
   4. Cutler Hammer
   5. Approved Equals

B. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, red pilot light, 1 NO 1 NC] auxiliary contacts, and push button operator.

C. Enclosure: NEMA ICS 6, NEMA Type 1 or 3R to meet conditions of installation.

2.2 FRACTIONAL-HORSEPOWER MANUAL CONTROLLER

A. Manufacturers:
   1. Siemens
   2. General Electric
   3. Square D
   4. Cutler Hammer
   5. Approved Equals

B. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and toggle operator.

C. Enclosure: NEMA ICS 6, Type 1 or 3R to meet conditions of installation.

2.3 MOTOR STARTING SWITCH

A. Manufacturers:
   1. Siemens
   2. General Electric
   3. Square D
   4. Cutler Hammer
   5. Approved Equals

B. Product Description: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, with red pilot light and push button operator.

C. Enclosure: NEMA ICS 6, Type 1 or 3R to meet conditions of installation.

2.4 FULL-VOLTAGE NON-REVERSING CONTROLLERS

A. Manufacturers:
   1. Siemens
   2. General Electric
   3. Square D
   4. Cutler Hammer
   5. Approved Equals

B. Product Description: NEMA ICS 2, AC general-purpose Class A [magnetic] [solid-state] controller for induction motors rated in horsepower.

C. Control Voltage: 120 volts, 60 Hertz.

D. Overload Relay: NEMA ICS 2; bimetal.

E. Product Features:
1. Auxiliary Contacts: NEMA ICS 2, (1) each normally open closed field convertible contacts in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated .
4. Pushbuttons: Recessed or Shrouded type.
5. Indicating Lights: Transformer Resistor or LED type.
6. Selector Switches: Rotary type.
7. Relays: NEMA ICS 2.
8. Control Power Transformers: 120 volt secondary, in each motor starter. Or as indicated on Drawings. Furnish fused primary and secondary, and bond un-fused leg of secondary to enclosure.

F. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.

G. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using motor circuit protector conforming to NEMA AB 1, with integral instantaneous magnetic trip in each pole. Obtain IEC Class 2 coordinated component protection.

H. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using non-fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle.

I. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate NEMA FU 1, Class R or J fuses. Obtain IEC Class 2 coordinated component protection.

J. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R.

2.5 TWO-SPEED CONTROLLERS

A. Manufacturers:
1. Siemens
2. General Electric
3. Square D
4. Cutler Hammer
5. Approved Equals

B. Product Description: NEMA ICS 2, AC general-purpose Class A [magnetic] [solid-state] controller for induction motors rated in horsepower. Include integral time delay transition between FAST and SLOW speeds.

C. Control Voltage: 120 volts, 60 Hertz.

D. Overload Relay: NEMA ICS 2; bimetal.

E. Product Features:
1. Auxiliary Contacts: NEMA ICS 2, (1) each normally open or closed field convertible contacts in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, duty oiltight type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated.
4. Pushbuttons: Unguarded Recessed or Shrouded type.
5. Indicating Lights: Transformer [Resistor or LED type.
6. Selector Switches: Rotary type.
7. Relays: NEMA ICS 2, .
8. Control Power Transformers: 120 volt secondary, in each motor starter or as indicated on Drawings. Furnish fused primary and secondary, and bond un-fused leg of secondary to enclosure.

F. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.

G. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using motor circuit protector conforming to NEMA AB 1, with integral instantaneous magnetic trip in each pole. Obtain IEC Class 2 coordinated component protection.

H. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using non-fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle.

I. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate NEMA FU 1, Class [R] [J] fuses. Obtain IEC Class 2 coordinated component protection.

J. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type [3R] [4].

2.6 FULL-VOLTAGE REVERSING CONTROLLERS

A. Manufacturers:
1. Siemens
2. General Electric
3. Square D
4. Cutler Hammer
5. Approved Equals

B. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic or solid-state controller for induction motors rated in horsepower. Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.

C. Control Voltage: 120 volts, 60 Hertz.

D. Overload Relay: NEMA ICS 2; bimetal.

E. Product Features:
   1. Auxiliary Contacts: NEMA ICS 2, (1) each normally open or closed field convertible contacts in addition to seal-in contact.
   2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type.
   3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated.
   4. Pushbuttons: Recessed or Shrouded type.
   5. Indicating Lights: Transformer Resistor or LED type.
   6. Selector Switches: Rotary type.
   7. Relays: NEMA ICS 2.
   8. Control Power Transformers: 120 volt secondary, in each motor starter or as indicated on Drawings. Furnish fused primary and secondary, and bond un-fused leg of secondary to enclosure.

F. The following Controller Types as shown on the drawings.

G. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.

H. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using motor circuit protector conforming to NEMA AB 1, with integral instantaneous magnetic trip in each pole. Obtain IEC Class 2 coordinated component protection.

I. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using non-fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle.

J. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate NEMA FU 1, Class R or J fuses. Obtain IEC Class 2 coordinated component protection.

K. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from [steel finished with manufacturer's standard gray enamel.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R 4.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install enclosed controllers plumb. Provide supports in accordance with Section 16070.

B. Height: Maximum 6’-6” to operating handle.

C. Install fuses for fusible switches. Refer to Section 16491 for product requirements.

D. Select and install overload heater elements in motor controllers to match installed motor characteristics.

E. Install engraved plastic nameplates. Refer to Section 16075 for product requirements and location.

F. Neatly type label and place inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION 16421

SECTION 16442 - PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes distribution and branch circuit panelboards, electronic grade branch circuit panelboards, [and load centers].

B. Related Sections:
1. Section 16060 - Grounding and Bonding.
2. Section 16491 - Fuses.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:
1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
6. NEMA PB 1 - Panelboards.
7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. National Fire Protection Association:
1. NFPA 70 - National Electrical Code.

E. Underwriters Laboratories Inc.:
1. UL 67 - Safety for Panelboards.
2. UL 1283 - Electromagnetic Interference Filters.
3. UL 1449 - Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

B. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years [documented] experience.

PART 2 PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

A. Manufacturers:
1. Siemens
2. Square D
3. General Electric
4. Eaton – Cutler Hammer

B. Product Description: NEMA PB 1 panelboard.

C. Service Conditions:
1. Temperature: 105 degrees F.
2. Altitude: 7200 feet.

D. Panelboard Bus: Aluminum current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.

E. Minimum integrated short circuit rating of: as indicated on Drawings.

F. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Furnish interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.

G. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

H. Molded Case Circuit Breakers with Current Limiters: NEMA AB 1, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

I. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, 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 NEMA FU 1, Class RK-5 fuse.

J. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.

K. Enclosure: NEMA PB 1, Type 1.

L. Cabinet Front: Surface type, fastened with concealed trim clamps hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:
1. Siemens
2. Square D
3. General Electric
4. Eaton – Cutler Hammer

B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Aluminum, current carrying components, ratings as indicated on Drawings. Furnish Aluminum ground bus in each panelboard furnish insulated ground bus as indicated on Drawings.

D. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral.

E. Minimum Integrated Short Circuit Rating of: 10,000, 22,000, 65,000 amperes rms symmetrical for 240 volt panelboards; 14,000, 65,000 amperes rms symmetrical for 480 volt panelboards as indicated on Drawings.

F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.

G. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, 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 NEMA FU 1, Class RK-5 fuse.

H. Enclosure: NEMA PB 1, Type 1 or Type 3R.

I. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 6 inches deep, 20 inches wide for 480 volt panelboards.

J. Cabinet Front: Flush or Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb.

C. Install recessed panelboards flush with wall finishes.

D. Height: 6 feet to top of panelboard install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Install filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.

G. Install engraved plastic nameplates in accordance with Section 16075.

H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 5 empty 1 inch (DN27). Identify each as SPARE.

I. Ground and bond panelboard enclosure according to Section 16060. Connect equipment ground bars of panels in accordance with NFPA 70.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

C. Perform switch inspections and tests listed in NETA ATS, Section 7.5.

D. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.3 ADJUSTING

A. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 10% percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION 16442

SECTION 16510 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section "Lighting Control Panelboards" for panelboards used for lighting control.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, arranged by designation.

B. Product Schedule: For luminaires and lamps.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of luminaire.

D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: [Five] year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Recessed Fixtures: Comply with NEMA LE 4.

E. CRI of 80 CCT as indicated on the fixture schedule.

F. Rated lamp life of 50,000 hours.

G. Lamps dimmable from 100 percent to 10 percent of maximum light output.

H. Internal driver.

I. Nominal Operating Voltage: as indicated on the fixture schedule

1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging

B. 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.

C. Diffusers, and Globes:
1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm)

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Flush-Mounted Luminaire Support: Secured to outlet box.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch- (4-mm-) diameter aircraft cable supports
2. Ceiling mount with pendant mount with 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length
3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

K. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 16510

SECTION 16520 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section "Lighting Control Panelboards" for panelboard-based lighting control.
3. Section "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. LEED Submittals:

1. Product Data for Credit EA 5: For specified metering equipment.
2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

D. Delegated-Design Submittal: For luminaire supports.

1. Include design calculations for luminaire supports

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale and coordinated.

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.

D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.6 FIELD CONDITIONS

A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. Lamp base complying with ANSI C81.61

F. CRI and CCT as indicated on the fixture schedule

G. L70 lamp life of 50,000 hours.

H. Nominal Operating Voltage: as indicated on the fixture schedule

I. In-line Fusing: On the primary for each luminaire

J. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.

K. Source Limitations: Obtain luminaires from single source from a single manufacturer.

L. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum Form and support to prevent warping and sagging.

C. 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.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch ((3.175 mm)) minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

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.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. 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.

C. 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 requirements; 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. To be coordinated with the architect

D. 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, 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 or SSPC-SP 8.
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.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

2.6 Light pole

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.

B. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7**

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified **and the system will be fully operational after the seismic event**."
2. Component Importance Factor: **1.5**

C. Structural Characteristics: Comply with AASHTO LTS-6-M.

D. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.

E. Live Load: Single load of 500 lbf (2200 N) distributed according to AASHTO LTS-6-M.

F. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

G. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

1. Basic wind speed for calculating wind load for poles exceeding 50 feet (15 m) in height is **100 mph (45 m/s)**

   a. Wind Importance Factor: **1.0**
   b. Minimum Design Life: **50 years**
   c. Velocity Conversion Factor: **1.0**

2. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is **100 mph (45 m/s)**

   a. Wind Importance Factor: **1.0**
   b. Minimum Design Life: **25 years**
   c. Velocity Conversion Factor: **1.0**

H. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of **1.1**to obtain the EPA to be used in pole selection strength analysis.

I. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.7 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

B. Transformer-Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and to accept]. Include removable flanged access cover secured with bolts or screws.

2.8 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to **ASTM F 1554, Grade 55,** with a minimum yield strength of 55,000 psi (380,000 kPa).

1. Galvanizing: **Hot dip galvanized according to ASTM A 153, Class C**
2. Threading: **Uniform National Coarse** Class 2A.

B. Nuts: ASTM A 563, Grade A, Heavy-Hex

1. Galvanizing: **Hot dip galvanized according to ASTM A 153, Class C**

C. Washers: ASTM F 436, Type 1.

1. Galvanizing: **Hot dip galvanized according to ASTM A 153, Class C**

2.9 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section "Cast-in-Place Concrete."

B. Pre-Cast Foundations: Factory fabricated, 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. Concrete, reinforcement, and formwork are specified in Section "Cast-in-Place Concrete."

C. 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.

D. Anchor Bolts: Install plumb using manufacturer-supplied **steel** template, uniformly spaced.

3.2 POLE INSTALLATION

A. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section "Cast-in-Place Concrete."

B. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.

C. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-(150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch (25 mm) below top of concrete slab.

D. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

B. Steel Conduits: Comply with requirements in Section "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.4 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in 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: Comply with requirements in 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 foundation.

3.5 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

K. Comply with requirements in Section "Low-Voltage Electrical Power Conductors and Cables" and "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.6 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at luminaire location (Coordinate with the architect). Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section "Cast-in-Place Concrete."

3.7 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 Section "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.8 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. 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 IES testing guide(s):

a. IES LM-5.
b. IES LM-50.
c. IES LM-52.
d. IES LM-64.
e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. 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.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION 16520

SECTION 16721 - FIRE DETECTION AND ALARM SYSTEM

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 work of this section.

B. Division-16 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Provide an electrically operated, electrically supervised fire alarm system as described herein. Include control units, power supplies, alarm initiating and indicating devices, conduit, wire, fittings and accessories required to provide a complete operating system. Enclose entire system in raceway. Provide basic wiring materials which comply with Division 26, Basic Materials and Methods Sections for raceways, conductors, boxes, fittings, supports, etc.

B. Extent of fire alarm and detection systems work is indicated by drawings and schedules.

C. Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories. Provide components and systems, which are UL-listed and labeled for fire alarm. Provide fire alarm and detection systems and accessories, which are FM approved. Comply with State and local requirements as applicable.

D. Comply with applicable provisions of current NFPA 72 **and 2009 International Fire Code** Standards for Local Protective Signaling Systems Auxiliary Protective Signaling Systems, Remote Station Protective Signaling Systems (as applicable), local building codes, and meet requirements of local authorities having jurisdiction.

1.3 FIRE ALARM AND DETECTION SYSTEMS:

A. GENERAL:

B. SYSTEM TYPE: Analog addressable, non-coded. Either manual activation of a fire alarm station or activation of an automatic initiating device energizes all fire alarm signaling devices, sounding a non-coded alarm and providing device identification on an annunciator panel.

C. SYSTEM OPERATION: Provide system such that any manual station or automatic initiating device annunciates all alarm indicating units (bells, horns, buzzers, chimes, visual alarm lamps, etc.) continuously until the manual station or initiating device is restored to normal and the fire alarm control unit reset. Annunciate alarm signals by zone at the control panel and all remote annunciators. Provide all conductors, raceway, equipment and labor to accomplish the following:

1. Deactivate air supply and return fan units simultaneously by means of a supervised master fan shutdown relay with slave relays as required. Restart air units automatically after panel has been reset. Provide a bypass switch for master fan shut down relay for drill purposes, and indicate by a locked-in lamp that the circuit has been bypassed.

2. Selectively activate and/or deactivate fan units in accordance with schedule shown on the drawings.

3. Release all magnetic door holders upon activation of an alarm from any zone by use of a master relay in the control panel.

4. Provide supervised circuits for the following:

5. Fire alarm system shall report to central monitoring company as determined by the building owner Install one communications conductor pair from the fire alarm panel to the telephone terminal board. Make all connections at both the fire alarm panel and the telephone terminal board. Make arrangements at the appropriate stage of construction to arrange for the leased line. This request must be made at least two weeks prior to final connection.

6. Provide all required supervised and initiating circuits for elevator recall and supervision to meet requirements of the authority having jurisdiction.

7. Provide fire alarm control panel with capability of shutting down individual initiating devices for maintenance purposes without affecting the continued operation of other initiating devices.

8. The general fire alarm system shall not activate elevator recall, only the local device. Recall initiating detectors shall have auxiliary contacts. Appropriate wiring in conduit shall be run from the initiating devices to the elevator control panel. These devices shall also initiate an evacuation alarm.

9. Sprinkler Supervision. Provide a signal initiating and supervisory circuit to each sprinkler riser and subdivision. Provide continuous alarm signal upon actuation of any waterflow signal initiating device. Sound alarm until the condition has been corrected and panel manually reset as required by UL 864. Provide separate alarm zones for: (1) alarm zones from "waterflow alarms", (2) alarm zones from "supervisory alarm" indicating sprinkler system trouble. Provide power to all sprinkler system alarm bells furnished under Section 15.

10. Provide relays as required at control panel of kitchen hood suppression system for initiation of alarm signal to the fire alarm control panel. Connect kitchen hook suppression system to separate zone on the fire alarm control panel. Connect hood suppression control panel shut trip breakers as required.

11. Provide manual fire alarm stations in boiler rooms, and main administrative office. Provide external alarm horns sufficient to be heard in all parking areas.

1.4 SUBMITTALS:

A. PRODUCT DATA: Submit manufacturer's data on fire alarm and detection systems including, but not limited to, roughing-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals. Also include standard or typical riser and complete wiring diagrams for panel and system.

B. SHOP DRAWINGS: Provide shop drawings showing equipment/device locations and connecting wiring of entire fire alarm and detection system. Include wiring diagrams and riser diagrams of panel.

C. CERTIFICATION: Submit a written statement to the Architect and the state and local Fire Marshal's Office that each device of the fire alarm system has been installed, inspected and tested in accordance with applicable requirements of NFPA Standard 72. This statement shall be submitted at the time of completion of the fire alarm system installation.

D. Provide to the Fire Marshall's office the following:

1. A complete set of shop drawings indicating:
   a. Location of all alarm-initiating and alarm-signaling devices.
   b. Point-to-point wiring diagrams for all alarm-initiating and alarm-signaling devices.

2. Wiring diagrams for:
   a. Alarm control panels.
   b. Auxiliary function relays and solenoids.
   c. Remote signaling equipment.

3. Standby battery calculations.

4. A complete equipment list identifying:
   a. Type
   b. Model
   c. Manufacturer
   d. Manufacturer catalog data sheets
   e. UL Listing and/or FM approval showing compatibility of device with Fire Alarm Control Panel (FACP)

5. A complete list identifying all:
   a. Alarm-initiating and alarm-signaling devices.
   b. Remote signaling and auxiliary function devices.

6. A complete Certificate of Compliance

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. MANUFACTURER: Subject to compliance with requirements, provide fire alarm and detection systems of one of the following:
   1. Edwards Systems Technology G.E.
   2. Mircom
   3. Notifier Div., Emhart Corp.
   4. Simplex Grinnell

2.2 FIRE ALARM CONTROL PANEL:

A. The fire alarm control panel shall be microprocessor-based. Each loop shall be capable of 99 analog addresses and 98 monitor and/or control addresses.

B. If the microprocessor fails, the system shall execute a default-signaling program. This program will enable the panel to sound the audible signals and report to central monitoring station. In addition, a red LED shall light to indicate the device where the alarm originated. Inability of the system provides this function during microprocessor failure shall not be acceptable.

C. The fire alarm control panel shall contain a 80 digit alphanumeric display and permit the user to perform all necessary functions including but not limited to the following:
   1. Alarm/Trouble Acknowledge.
   2. Alarm Silence
   3. Reset

4. Lamp Test
5. Control of Initiating Devices (on/off)
6. Control of output modules (on/off)
7. Change sensitivity of devices
8. Change time
9. Walk test
10. Check system on battery voltage and current

D. The fire alarm control panel shall be capable of alarm verification. The control panel shall indicate which smoke detector is in alarm during the pre-alarm window.

E. All alarm signals shall be locked in at the panel until the operated device is returned to it's normal condition and the control panel is manually reset.

F. Alarm or trouble activation of initiating points shall be represented in English on the alphanumeric display on both the remote operating panel and the fire alarm control panel indicating the address of the specific device.

G. Each initiating and signal circuit shall be electrically supervised for opens, shorts, and ground faults in the wiring.

H. The occurrence of any fault shall activate the system trouble circuitry but shall not interfere with the proper operation of any circuit that does not have a fault condition.

I. The system communication loops shall be capable of being wired using Class "A" (Style 6) supervised circuits a ground fault on either conductor or a break shall not prevent a device from operating on either side of the break.

J. The fire alarm control panel shall contain circuitry permitting the transmission of trouble and alarm signals over leased phone lines by the means of reverse polarity. There shall be a supervised disconnect switch to allow testing of the fire alarm control panel without transmitting an alarm to the central station.

K. The fire alarm control panel shall include the following features.
1. Auxiliary SPDT alarm actuated contacts.
2. Auxiliary SPDT trouble actuated contacts.
3. A solid-state power transfer circuit that shall switch to standby power automatically and instantaneously if normal power fails or falls below 15% of normal ("brown out" conditions). This electronic circuit shall allow the batteries to be effectively "floated" on the operating system to avoid upsetting the normal microprocessor scan and minimize resultant nuisance troubles and/or alarms.
4. A ground fault detector to detect positive or negative grounds on the initiating circuits, signal circuits, power circuits, and telephone line circuit. A ground fault code on the alphanumeric display shall provide indication of either a positive or negative ground fault and shall operate a general trouble but shall not cause an alarm to be sounded.
5. A short circuit error message shall be a standard feature of the fire alarm control panel. Each communication loop shall be monitored and shall have a distinctive error message.
6. Lightning protection shall be a standard feature of the fire alarm control panel and shall be incorporated in the power supply circuit, common control circuits, signal circuits, and telephone line circuit.
7. Individual circuit breakers shall be provided for the following: smoke detector power, main emergency power supply, signal circuit #1, signal circuit #2, battery

standby power, and auxiliary output.

8. The fire alarm control panel shall be of dead-front construction. One key shall allow access to all electronics or to the dead-front access to the operator functions.
9. Opening the main door shall expose all components for inspection or adjustment without further dismantling of the cabinet, control unit, or wiring.
10. It shall be possible to check and adjust the sensitivity of all analog devices from the main fire alarm panel.

L. The fire alarm control panel shall have batteries capable of powering the system for (24) hours in standby condition and (5) minutes in alarm.

M. There shall be no special tools required for the programming of devices. A standard slot head screwdriver only.

2.3 REMOTE ANNUNCIATOR PANEL: (If Shown)

A. Remote annunciator panel shall have all the same features as the main fire alarm control panel.

B. Remote Annunciator Panel shall contain 80 digit alphanumeric display providing status of all devices including the fire alarm control panel.

C. Remote Annunciator Panel shall permit the user to perform all necessary functions including but not limited to the following:

1. Alarm/Trouble Acknowledge
2. Alarm Silence
3. Reset
4. Lamp Test
5. Control of Initiating Devices (on/off)
6. Control of Output Modules (on/off)
7. Change sensitivity of devices
8. Change time
9. Walk test
10. Check System on battery voltage and current

2.4 PERIPHERAL DEVICES:

A. Remote identification module devices shall be attached to any single normally open initiating device heat detector, water-flow switch, duct detectors, sprinkler, tamper switches, kitchen hood, pull station, etc. The modules shall supply addressing and status information to the system through the dual loop module.

2.5 CONTROL POINT MODULES:

A. The control point module shall be connected to the same loop as the initiating devices, and shall provide a relay output (Form "C" 2 Amp @ 24 VDC, resistive only).

B. This relay output shall be used to perform auxiliary functions.

C. When the AOM is activated, the red "ACTIVE" LED shall be on solid. Under normal conditions, the red "ON LINE" LED shall flash.

2.6 MANUAL FIRE ALARM STATION:

A. Provide red enclosure, manual fire alarm stations with the following features:
1. Die-cast or polycarbonate constructions, for semi-flush mounting.
2. Addressable alarm type electrically compatible with system requirements.
3. Double Action
4. Break glass design requiring unit to be opened for resetting, and requiring resetting before closing.
5. Electrically compatible with system requirements.
6. Key reset, keyed like fire control panel. Provide one spare "glass" for each station required.

2.7 IONIZATION SMOKE DETECTORS:

A. All ionization smoke detectors shall be capable of being replaced without disconnecting any wires or wire connectors from the base of the detector. Each detector shall be installed on a separate base. The detector base shall be capable of receiving a photoelectric, ionization, or electronic thermal detector. All ionization fire detectors shall be UL 268 listed. All detectors shall have (2) viewable LEDs to indicate the status of the device.

2.8 DUCT FIRE DETECTORS WITH SAMPLING TUBE):

A. Provide ionization type with UL 268A listings. Each detector shall be equipped with a remote light located as on the drawings. Each detector shall have (2) form "c" alarm contacts rated at10 amps.

2.9 THERMAL DETECTORS:

A. Thermal detectors shall operate on the Rate-of-Rise principal. The detectors shall have a fixed temperature rating of 135 degrees Fahrenheit.

B. The heat detector shall consist of a base and a head.
1. The base shall be capable of accepting either a smoke detector or a 135 degree heat detector.
2. The head shall automatically restore to its normal standby condition when the temperature returns to its normal range.

2.10. AUDIOVISUAL ALARM HORNS SEMI-FLUSH MOUNTED:

A. Provide audio-visual alarm horns with the following features:

1. Polycarbonate construction, finished in red enamel, suitable for indoor or outdoor application.

2. Capable of 90 db sound level at 10 feet.

3. Integrally mounted flashing light unit, with Lexan lens with block letters "FIRE", and minimum flash rate of ONE per second, and 75 candela minimum.

4. Electrically compatible with system requirements.

5. Horns shall sound the temporal pattern (code 3) until silenced.

6. Audiovisual alarm horns shall have the ability to silence horns while maintaining the strobe flash, until reset.

7. Maximum horns, horn/strobes and or strobes shall not exceed 70% of the indicating circuit capacity.

2.11 AUXILIARY RELAY

A. Remote auxiliary relay boards shall be rated at 10 AMPS @ 120 VAC. A red LED shall light to indicate relay activation. All relays shall transfer on general alarm and latch on until reset. All relays shall be supervised. The control output provided can be used in conjunction with fire alarm applications (i.e. fan controls, dampers, doors, and any other general alarm control).

2.12 ZONE MODULES:

A. Provide style "6" zone modules capable of receiving and annunciating an alarm from any detector, even with a single fault condition on any on any initiating circuit.

B. Power all smoke detectors from the "Style 6" initiating loop wiring. For systems, which power smoke detectors separately from the "Style 6" loop, provide monitoring for both the power source and the independent zone wiring, so that complete trouble and alarm indication is achieved by zone. Provide capability to operate all smoke detectors, even with a single fault condition on the smoke detector power wiring. Provide the number of zones shown on the fire alarm zone schedule (see drawings).

2.13 SIGNALING MODULES:

A. Provide signaling as required. Provide power adequate to sound all signaling devices concurrently. Provide supervised indicating circuits for polarized 24V D.C. alarm signaling devices. Provide 30% spare capacity.

B. Each signal circuit shall have a separate disconnect switch for servicing the fire alarm system. Each and every indicating circuit shall have a distinct location description. Power supply shall be at fire alarm control panel. Remote power supplies and indicating circuits will not be acceptable.

2.14 SYSTEM CONFIGURATION PROGRAMMING:

A. To help the owner in programming, system changes, and servicing, the fire alarm system shall have the following functions.

1. The FACP shall be capable of an auto-configuration, which via a password, all analog devices and panel modules are automatically programmed into the system. At this point the system will operate as a general alarm system without any other programming.
2. If any two devices are addressed the same, the LED's on both devices will light steady and the panel will read "extra address and the address number".

3. If any device is installed and not programmed into the system the LED will light steady and the panel will read the same as above.

2.15 BATTERIES:

A. Provide Gel Cell standby batteries capable of operating fire alarm system for minimum of 24 hours, then operating all indicating units for at least five minutes. Locate batteries in fire alarm control unit, or in similar type enclosure located as directed. Provide all interconnecting wiring. Batteries shall be sized to handle all future devices for a complete building build-out.

PART 3 - EXECUTION

A. WIRING

1. All new wire used on the fire alarm system shall be U.L. Listed as fire alarm protective signaling circuit cable per NEC, Article 760. Bell wire or thermostat wire is not acceptable.

2. If twisted or shielded wire is required or recommended by the manufacturer it must be used.

3. All wiring shall be in conduit or in fire alarm rated red MC cable.

3.2 FINAL ACCEPTANCE

A. GUARANTEE:

1. Furnish a three-year guarantee for all equipment, materials and installation, including all labor, transportation, and equipment.

2. Emergency Response. The fire alarm equipment supplier shall provide an emergency response within four hours of any reported system failure to resolve the problem on a continuous basis.

3.3 FINAL TEST:

A. Before the installation shall be considered completed and acceptable, a test on the system shall be performed as follows:

1. The contractor's job foreman, a representative of the manufacturer, a representative from the building maintenance department shall operate every building fire alarm device to ensure proper operation and correct annunciation at the control panel.

2. The supervisory circuitry of the initiating and indicating circuits shall also be verified.

3. Provide the following spare devices:
   a. 3 thermal detectors with bases
   b. 2 strobe/horns
   c. 1 manual pull station with addressable modules

3.4 LABELING:

A. All devices shall be labeled with their appropriate address under the device cover.

B. All initiating devices shall be programmed to include the device address and a complete user text English location description. i.e. Device L4S76, Smoke Detector, 1st floor Rm.17.

3.5 AS BUILT DRAWINGS:

A. A complete set of CAD "AS BUILD" drawings showing installed wiring, color-coding, specific interconnections between all equipment and internal wiring of the equipment shall be delivered to the owner upon completion of the system.

B. A building map shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building fire alarm map inside fire alarm panel. The building map shall indicate the various by the use of different colors (minimum of five colors).

C. The disk containing the files shall be supplied to the owner. These disks shall include all information required to allow the Owner to change the fire alarm program. These computer disks shall contain a minimum of the following:

1. CAD drawing files of building fire alarm map
2. CAD drawing files of as-built fire alarm components and point to point connections.
3. General configuration programming.
4. Job specific configuration programming.
5. Tutorial file on complete programming of fire alarm system.

3.6 OPERATING AND MAINTENANCE MANUALS:

A. Operating and maintenance manuals shall be submitted prior to testing of the system. Total of (3) manuals shall be delivered to the Owner. Manuals shall include all service, installation, and programming information.

3.7 TRAINING:

A. Provide four (3) hours training on the operation and installation of fire alarm system, at job site, at no cost to owner.

END OF SECTION 16721

SECTION 16740 - TELEPHONE/DATA RACEWAY SYSTEM

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:
1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Firestopping relating to electrical work.
7. Firestopping accessories.
8. Fire Retardant Telephone Terminal Boards

1.2 RELATED SECTIONS AND DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and ALL other sections of Division 16

B. Equipment requiring rough-ins and/or connections by Division 16 may be shown on the architectural drawings and/or specified in Sections 1 through 15 Division 16 is responsible for these rough-ins and/or connections whether shown on the electrical drawings or not.

1.3 DESCRIPTION OF WORK:

A. The extent of telephone system work is indicated by drawings and is hereby defined to include, but not be limited to raceways, outlet boxes, backboards, grounding and miscellaneous items required for complete raceway system. All cabling is to be installed by the Utah State Department of Information Technology Services (ITS).

B. Refer to other Division-16 sections for requirements for raceways, trays, boxes and fittings, wiring devices, and supporting devices, and other sections, as applicable.

1.4 QUALITY ASSURANCE:

A. Comply with applicable portions of NEC as to type products used and installation of components. Provide products and materials which have been UL-listed and labeled.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide complete raceway system for telephone including but not limited to, raceway, boxes, outlet and blank plates, backboards, grounding and miscellaneous items as required.

B. Provide 4" square box with appropriate plaster or tile ring.

C. Provide fire treated, or hypalon coated plywood terminal backboards, 4' x 8' x ¾" unless noted otherwise.

D. Provide terminal cabinets of code gauge steel, flush or surface, as indicated, with concealed trim clamp, concealed hinges and flush lock, with gray baked enamel finish to match finish of panelboard covers. Construct back boxes of code gauge galvanized steel with removable end walls.

PART 3 - EXECUTION

3.1 INSTALLATION OF TELEPHONE SYSTEM RACEWAY:

A. Install raceway system as indicated to comply with NEC and recognized industry practices. Install a ¾" conduit from each telephone, data or combination telephone/data outlet to telephone/data terminal backboard, tray, or terminal cabinet unless otherwise noted on the drawings. Provide nylon pull cord in all empty raceway.

B. GROUNDING: Provide one #6 copper ground conductor from the Main Distribution Frame (MDF) and each Intermediate Distribution Frame (IDF) telephone terminal board to the service entrance ground. Enclose in suitable raceway for entire length. Provide a copper ground terminal buss at each telephone board with minimum of (6) Six terminal lugs to receive minimum of #10 ground conductor. Make connection at service entrance ground. See drawings for additional requirements.

C. POWER: Provide minimum of one duplex power receptacle on a dedicated circuits adjacent to each terminal backboard or cabinet. Provide additional outlets and circuits as shown or detailed on the drawings.

END OF SECTION 16740

07 | SITE TECHNICAL INFORMATION

7.1 Geotechnical Investigation Report

Geotechnical Investigation Recommendations are hereto incorporated. Geotechnical Investigation Report will follow this document as an Addendum.

WESTERN TECHNOLOGIES INC.
420 West Lawndale Drive
Salt Lake City, Utah 84115
Phone No. 801-972-3650, Fax No. 801-972-3653

Date: **October 17, 2014**

To: **Archiplex Group, Mr. Ralph Stanislaw**

From: **Warren D. Clyde, P.E.**

Project: **UDOT Maintenance Station - Hooper**

WT Project No: **6124JT125**

PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

Shallow Foundations

Bearing Pressure (psf): 1500 on native medium dense sand or engineered fill.

Liquefaction Inducted Settlement Potential: Based upon our borings liquefaction of the sandy soils is Anticipated and will be a factor for design considerations. The building may require an engineered fill pad along with other structural measures such as grade beams.

Bearing Depth (ft.): 2.5 feet (frost depth) Minimum Width (ft.): 2 feet

Groundwater Depth (ft): 5 feet below existing site elevations

Lateral Loads

Coefficient of Friction: 0.30 on native sand or engineered fill

Passive Pressure (pcf): 300 on native sand or engineered fill

Floor Slabs

Thickness of ¾ inch clean gravel or untreated base (in.): 4

On-Site Pavements

Subsoils at subgrade depth are silty sand and clay with a poor to fair bearing capacity in saturated conditions.

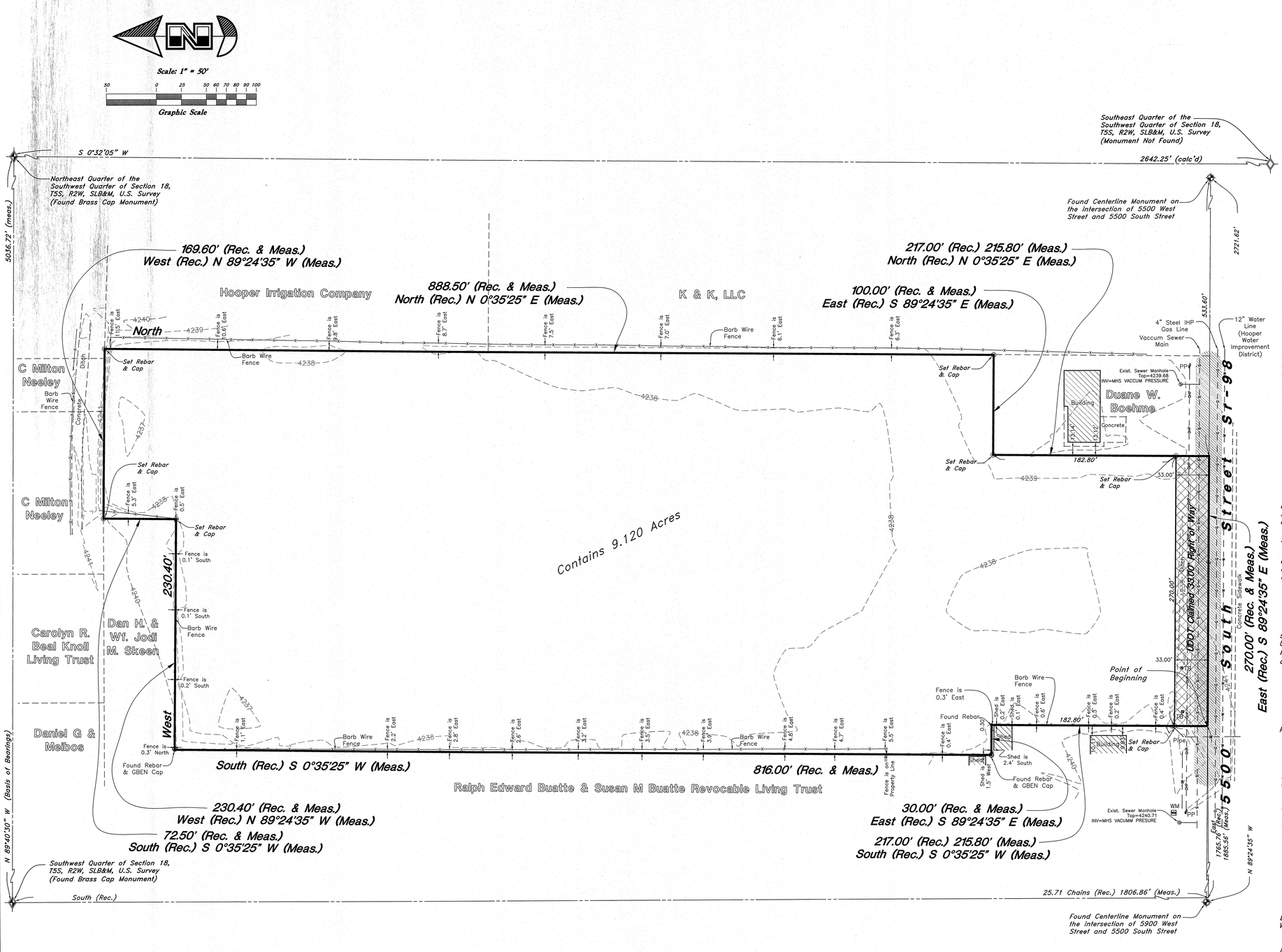
Earthwork

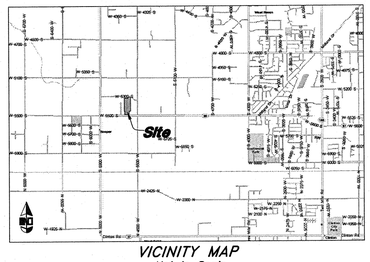
Groundwater is shallow at 5 feet, utility construction may require dewatering. Clay and silty sand soils may require stabilization if in a wet condition.

THIS SUMMARY PRESENTS CURSORY DESIGN RECOMMENDATIONS. FINAL RECOMMENDATIONS ARE PENDING COMPLETION OF THE LABORATORY TESTS. PRIOR TO FINALIZING THE DESIGN DOCUMENTS, THE FORTHCOMING GEOTECHNICAL EVALUATION SHOULD BE CONSIDERED IN ITS ENTIRETY.

7.2 Alta Survey

Alta Survey is hereto incorporated.





VICINITY MAP
Not to Scale

NARRATIVE

This survey was requested by Ralph Stanislaw of Archiplex representing UDOT for the purpose of completing and ALTA/ACSM Survey and to establish property lines.

A line between the Southwest Quarter Corner and the Northeast Quarter of the Southwest Quarter of Section 18 was used for the Basis of Bearings.

Property corners were set as shown on this survey.

DESCRIPTION

A part of the Southwest Quarter of Section 18, Township 5 South, Range 2 West, Salt Lake Base and Meridian, U.S. Survey; beginning at a point 25.71 chains South and 1765.76 feet East from the Northwest Corner of the said Quarter Section, and running thence East 270 feet; thence North 217 feet; thence East 100 feet thence North 888.5 feet; thence West 169.60 feet; thence South 72.5 feet; thence West 230.4 feet; thence South 816 feet; thence East 30 feet; thence South 217 feet to the place of beginning.

Contains 397,286 Sq. Ft
or 9.120 Acres

EXCEPTIONS TO COVERAGE

Legal Descriptions and Exceptions to title are based on National Title Agency, LLC, File No. 5475062 with an effective date July 13, 2014 at 7:30 am.

Schedule B – Section 2

EXCEPTION 10 – NOT PLOTTED. 1969 Farmland Assessment Act Recorded February 1, 2000 as Entry No. 1687633, in Book 2056 at Page 393 of Official Records.

FLOOD PLAIN

This property lies entirely within flood zone X (unshaded) as shown on the FEMA Flood Insurance Rate Map for the City of Hooper, Utah, Community Panel Number 49057C0425E dated 15 Dec, 2005. Flood Zone X is defined as "Areas determined to be outside the 0.2% annual chance flood plain" (no shading)

ZONING INFORMATION

As per Optional Item 6 of Table A, No zoning information was provided at the time of the survey.

NOTES

1. Utilities shown are from observed evidence on the site or records available at the time of the survey.

2. There is no observed evidence of use of site as a solid waste dump, sump or sanitary landfill.

3. There is no observed evidence of current earth moving work, building construction or building additions.

4. There is no evidence of wetland areas as delineated by appropriate authorities.

CERTIFICATION

To First American Title Insurance Company, National Title Agency, LLC, Terraform Properties, Utah Department of Transportation, Duane W. Boehme and Chris Farrell.

This is to certify that this map or plat and the survey on which it is based were made in accordance with the 2011 Minimum Standard Detail Requirements for ALTA/ACSM Land Title Surveys, jointly established and adopted by ALTA and NSPS, and includes items 1, 2, 3, 4, 5, 11(b), 18, 19, and 20(a)(b) of Table A.

The field work was completed on August 13, 2014.

Date of Plat or Map: September 24, 2014.

PROFESSIONAL LAND SURVEYOR 9-30-14 No. 6242920 STATE OF UTAH

Andy Hubbard

License Number 6242920

LEGEND

—℄—	Centerline	TA	Top of Asphalt	C.M.P.	Corrugated Metal Pipe
– –UGT– –	Buried Telephone line	EA	Edge of Asphalt	R.C.P.	Reinforced Concrete Pipe
– –OHT– –	Overhead Telephone line	NG	Natural Ground	CONC	Edge of Concrete
– –OHP– –	Overhead Power line	LG	Lip of Gutter	RWALL	Retaining Wall
– –UGP– –	Power line	SP	Service Pole	SMH	Sewer Manhole
– –S– –	Sanitary Sewer line	LP	Light Pole	WV	Water Valve
– –W– –	Culinary Water line	PP	Power Pole	CB	Catch Basin
– –G– –	Gas line	TP	Telephone Pole	DV	Diversion Box
– –SD– –	Storm Drain line	FH	Fire Hydrant	TC	Top of Curb
– –SW– –	Secondary Waterline	DIT	Flowline of Ditch	SW	Sidewalk
– –LD– –	Land Drain line	TOE	Toe of Slope	GAS	Gas line Marker
– –IW– –	Irrigation Waterline	TOP	Top of Slope	GUY	Guy Wire
–X–X–X–	Fence Power Meter	CO	Cleanout	BLDG	Building Corner
	Power Pole	FC	Fence		Fire Hydrant
	Post		Flowline	NG	Natural Ground
WM	Water Meter	DMH	Drain Manhole		Water Valve
GM	Gas Meter	x99.00	Spot Elevation	LP	Light Pole
PM	Power Meter		Contour		Power Pole w/guy
	Telephone Box		Asphalt		Deciduous Tree
S	Sewer Manhole		Concrete		Coniferous Tree
D	Drain Manhole		Building	ARP	Area Reference Plat
W	Water Manhole		Catch Basin	COL	Building Columns
CO	Cleanout Box			LS	Landscaping
E	Electrical Manhole				

BENCHMARK

Found Monument near the Intersection of 5900 West Street and 5500 South Street (55.67 feet Northeast of the Intersection)

Elevation = 4240.22 feet

REV	DATE	DESCRIPTION

GREAT BASIN ENGINEERING
5746 SOUTH 1475 EAST OGDEN, UTAH 84403
MAIN (801)394-4515 S.L.C.(801)521-0222 FAX (801)392-7544
WWW.GREATBASINENGINEERING.COM

ALTA/ACSM Survey

UDOT – Hooper

5650 West 5500 South
Hooper City, Weber County, Utah
A part of Section 18, T5S, R2W, SLB&M, U.S. Survey

18 Aug, 2014

SHEET NO.
1

14N233 – ALTA